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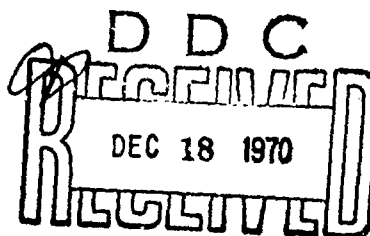
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## Education and Training in Aerospace Medicine 1970

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**ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT**  
**(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)**

**EDUCATION AND TRAINING IN**  
**AEROSPACE MEDICINE 1970**

Papers presented at the AGARD Aerospace Medical Panel Specialist Meeting  
held in Oslo, Norway on 12 and 13 May 1970.

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## SUMMARY

This volume contains the papers and summaries of ensuing discussion at the ACARD/NATO Aerospace Medical Panel Specialist Meeting, held in Oslo on 12th-13th May 1970. The topic was "Education and Training in Aerospace Medicine" and the contributions covered a wide range within that framework, including training of civil and military aeromedical practitioners, short-service medical officers, medical auxiliaries, flight nurses and aircrew. There was very valuable exchange of views on the approaches adopted by the various nations to these educational programmes and some detailed consideration of training techniques for aircrew.

A highlight of the meeting was the revelation of remarkable differences between nations in the attention given to survival training. The resultant exchange of information should be the stimulus for further study of this very important aspect of military crew training. It was commented that there was, in addition, a relevance to civil flying now that an increasing number of routes crossed sparsely populated areas of extreme climatic conditions.

## RESUME

Ce volume comporte les rapports présentés ainsi qu'un résumé de discussions au cours de la réunion de Spécialistes du Groupe de Médecine Aérospatiale d'ACARD/OTAN à Oslo les 12 et 13 mai 1970. Les communications sur "L'Enseignement et l'entraînement en médecine aérospatiale" touchèrent sur un grand nombre d'aspects comprenant l'entraînement de médecins militaires spécialistes en médecine aéronautique, médecins militaires de carrière, aides, infirmières de vol et personnel navigant. Au cours de la réunion il y a eu un échange utile de points de vue sur les méthodes employées par les différentes nations, ainsi qu'une discussion poussée des méthodes d'entraînement du personnel navigant.

Le point culminant de la réunion fut la démonstration de différences remarquables entre les nations en ce que concerne l'importance de l'entraînement à la survie. Cet échange d'idées devrait provoquer d'autres études sur cet aspect important de l'entraînement d'équipages militaires. On a commenté qu'il y avait en plus, un rapport à l'aviation civile maintenant qu'un nombre plus important de routes traversent des lieux peu peuplés et de conditions climatiques exceptionnelles.

Panel Chairman : Group Captain T.C.D. Whiteside, MBE, RAF

Deputy Chairman : Médecin en Chef de 1ère Classe F. Violette, FAF

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## FOREWORD

One of the original functions of AGARD is the dissemination of information, and yet the present Symposium is the first to bring together the individuals in the various NATO countries whose main task is that of educating and training civil or military personnel in aviation medicine. In making any comparison of courses, two factors must be considered: the level of teaching and the coverage of the subject required by the particular students. In the present context, both of these cover a wide spectrum.

The level of teaching ranges from the elementary lectures for aircrew on a Station to the highly specialised courses in aviation medicine for specialist medical officers. The subject itself ranges from the nuts and bolts of personal equipment to the design of questionnaires. It encompasses, for example, training in survival, the use of personal equipment, physiological responses to a stressful environment, behavioural responses under particular conditions of physical and mental stress and of fatigue, medical fitness standards and specialist clinical examination.

The difficulty in teaching this subject is to combine these two factors in the right proportion within the time allocated, sometimes reluctantly, from an already full training programme.

The meeting has, to judge from its lively discussion periods, been highly successful in achieving a comparison of different ways in which the task of training in aviation medicine can be accomplished. This volume will, I hope, be useful, not only as a reminder for participants, of the material presented, but also as a review of the way in which this subject is treated in some of the foremost aeromedical training establishments in the NATO countries.



(T. C. D. WHITESIDE)  
Group Captain, Royal Air Force  
Chairman of the Aerospace Medical Panel  
AGARD

## PREFACE

It is hoped that this volume will serve as a useful guide to those interested in the dissemination of aeromedical knowledge and expertise. In the papers one may find summaries of teaching programmes, explanation of underlying philosophy and comments on the effectiveness of teaching.

As is so often the case, the discussion after the papers, both formal and informal, proved of great value. There was valuable exchange on each of the topics, particularly aeromedical training of aircrew.

In preparing the proceedings for publication I have taken three steps which I hope will be accepted as they are intended, namely as aids to readability. Firstly, I have made some modifications to papers written in English by those for whom this is not their first language, in an effort to conform with common English usage without altering the basic style of the writers. Secondly, I have included the three papers from France in their English translations as prepared by AGARD. Doubtless their authors will be willing to provide original-language copies for those who desire them. Thirdly, I have paraphrased and condensed the discussion on the basis of notes and tape-recordings to retain the gist of the exchanges of views in a readable version. I must take full responsibility for any misrepresentation or misinterpretation which may have occurred during this process.

Being personally deeply involved in the training of Medical Officers in Aviation Medicine I was particularly interested in the relevant part of sessions I and II. With the agreement of the Chairman I followed up the meeting by sending questionnaires on training courses to the AGARD member countries and I am grateful to those who were kind enough to provide the relevant data. From their replies and the information contained in the papers I have been able to tabulate certain details which I hope will be of interest. They will be found as item 21 in this volume.

D I FRYER  
Wing Commander, RAF  
Editor

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AT THE OPENING CEREMONY OF THE AGARD SPECIALIST MEETINGS IN OSLO 12-14 MAY, 1970

Dear Members - Dear Guests!

On behalf of the Royal Norwegian Air Force, hosts for this conference, it is my great pleasure and honour to wish you all a hearty welcome to these two Specialist Meetings, to Oslo, and to Norway.

The idea of AGARD is, through a close contact between research institutions and persons - military and civilian, to stimulate and to coordinate scientific efforts in areas of importance to air missions in our NATO alliance - and to spread information in this field to all those who may benefit therefrom.

As Norway this time has the privilege to be the seat of the conferences, we are happy to have the opportunity to see as our special invited guests representatives from agencies and groups of persons in our country who are concerned with the problems under discussion in these panel meetings. We are honoured to welcome representatives from the Armed Forces Medical Service - and from the Armed Forces Department of Psychology, from the Navy Medical Service, from the Faculty of Medicine, University of Oslo, from the Directorate of Civil Aviation, from the State Inspectorate of Safety in Work, from the Medical Service of Scandinavian Airlines System and from the group of Industrial Officers in Norway - who have long been highly dedicated to the task of solving the health problems of shift work. I hope that the coming days will be valuable for all participating and attending the meetings.

Following this welcome the Surgeon General of the Armed Norwegian Forces, Major General Torstein Dale, addressed the meeting and greeted the participants from member nations of NATO.

Group Captain T. C. D. Whiteside, Royal Air Force, Chairman of the Aerospace Medical Panel of AGARD thanked Colonel Nyby and General Dale for their generous remarks and, on behalf of all present, expressed gratitude to the Royal Norwegian Air Force for their hospitality in making possible the holding of this Specialist Meeting in such a delightful venue and such elegant immediate surroundings. He then handed over the meeting to Brigadier General Lauschner as Chairman of the first session.

Brigadier General Lauschner outlined the aims of the Specialist Meeting and the subdivision of the programme and called upon the first speaker.

**AEROMEDICAL TRAINING IN THE CANADIAN FORCES**

**Major C.A. Burden**

**School of Aviation Medicine**

**Canadian Forces Institute of Environmental Medicine**

### Summary

This paper describes the current aeromedical training programmes in the Canadian Forces. The activities of the School of Aviation Medicine in training aviation medical personnel is discussed. Also presented is the organization and activities of the Aeromedical Training Units in the field in order to illustrate the continuing education and training of aircrew and jet passengers. Operational aeromedical support is mentioned as a part of the field aeromedical unit function. In describing the School of Aviation Medicine, the paper gives a resumé of the courses given to Flight Surgeons, Bioscience Officers, Bioscience Technicians, Flight Safety Officers, aircrew and jet passengers. Additional training available to Flight Surgeons and Bioscience Officers is included, as is School of Aviation Medicine assistance in the aeromedical education of civilian aircrew.

### Sommaire

Ce papier décrit les programmes d'entraînement en sciences biologiques présentement en usage dans les Forces Canadiennes. Les activités de l'Ecole de Médecine Aéronautique concernant l'entraînement du personnel en médecine aéronautique est discuté. Aussi présenté est l'organisation et les activités des Unités d'Instruction en Médecine Aéronautique dans le champ pour illustrer l'éducation et l'entraînement continu des membres de l'équipage de l'équipage et des passagers des avions à réaction. Le support en médecine aéronautique opérationnel est mentionné comme faisant parti des fonctions des Unités d'Instruction en Médecine Aéronautique dans le champ. En décrivant l'Ecole de Médecine Aéronautique le papier donne un résumé des cours donné aux médecins de l'air, aux officiers spécialistes en sciences biologiques, aux spécialistes en sciences biologiques, aux officiers de la sécurité aérienne, aux membres de l'équipage et aux passagers des avions à réaction. L'entraînement additionnel pour les médecins de l'air et les officiers spécialistes en sciences biologiques est inclus, de même que la contribution de l'Ecole de Médecine Aéronautique dans l'éducation en médecine aéronautique des membres de l'équipage civil.

Aeromedical training may be divided into two parts, one dealing with the education and training of personnel in the practice and teaching of aviation medicine and its ancillary disciplines, the other part dealing with the education and training of those personnel actually engaged in flying, namely aircrew and jet passengers. In the Canadian Forces, personnel who are directly concerned with the education and training of aircrew and jet passengers are: Flight Surgeons, Bioscience Officers (known in some countries as Physiological Training Officers), Bioscience Technicians, and Flight Safety Officers. These personnel are trained by the School of Aviation Medicine, which is an integral part of the Canadian Forces Institute of Environmental Medicine (CFIEM). Aircrew and jet passengers are trained at Aeromedical Training Units (AMTU) of which there are five. The AMTU concerned with the initial aeromedical training of aircrew is located with Training Command, the AMTU's which give operational and continuing aeromedical training to aircrew are located with, and are under the command of, Operational Training Units (OTU).

#### PART 1

The School of Aviation Medicine (SAM) conducts two courses per year for Flight Surgeons; each course is two months long which gives 40 training days. The optimum number of students per course is considered to be five, although up to ten can be accommodated. The aim of the course is to introduce selected medical officers to the basic principles of the practice of Aviation Medicine and to indicate ways of applying these principles to enhance the safety and effectiveness of Canadian Military Aviation. Candidates for the course should have at least six months experience on a flying base and normally should have more than two years to serve. They should be able to meet the lowest physical standards for aircrew (visual category excepted) and must be prepared to fly in service jet aircraft to undergo decompression training. Since the great majority of students will be serving two to three years on an active flying base, emphasis is placed upon methods of active support to the operation. To stimulate interest, a number of closely related subjects are also outlined in the lecture material, field visits and exercises.

The following subjects are emphasized, with their applied physiology where applicable:

- a. oxygen systems including liquid systems;
- b. aircraft pressurization and decompression sickness;
- c. acceleration and orientation;
- d. clinical aviation medicine;
- e. Flight Surgeon support of military operations; and
- f. accident and incident investigation including aviation pathology.

The following subjects are outlined briefly:

- a. history of aviation medicine;
- b. pressure suits;
- c. treatment of dysbarism and submarine medicine;
- d. aircrew selection and training;
- e. principles of flight and aircraft instrumentation;
- f. human engineering;
- g. air traffic control problems;
- h. biostatistics;
- j. aviation public health and industrial hygiene;
- k. space medicine; and
- m. operational problems.

The foregoing subjects are covered in the lectures by CFIEM staff, military and civilian guest lecturers and by films. Use is made of practical demonstrations, tape recorders, slide projection and other available training aids. Field visits are made to the Directorate of Flight Safety (DFS), the Aeronautical Experimental and Test Establishment (AETE), the various Command Headquarters for briefings, a field AMTU, a major air traffic control centre, and an aircraft manufacturer. In order to give the Flight Surgeons as varied a flying familiarization as possible, visits are made to bases which have the Primary Flying School, the Flying Training School, Operational Training Units and as many operational bases as possible. As an example, the last course conducted had flight experience in the Chipmunk, the CL 41 Tutor trainer, the T 33 Silver Star, the CF 101 Voodoo, the CHSS-2 Sea King ASW helicopter, the Argus Maritime Patrol aircraft, the L 19 reconnaissance aircraft and the CH 112 Light Observation Helicopter. The field trips are considered to be a most important part of the Course from the point of view of education, orientation, creation of interest in aviation and an appreciation of the aviation environment.

Students are assessed on a multiple choice mid term examination, a practical problem final examination, an original paper and an accident investigation exercise. After graduation the link with the School is not broken. Their work in the field is assessed, accident boards reviewed and Flight Surgeons have direct access to the School and Institute on aviation medical matters.

Flight Surgeons have further opportunity to qualify for a Certificate in Military Medicine (A) the qualification, criteria for which are;

- a. an approved internship of at least one year;
- b. a minimum of three years experience as a general duty medical officer with an operational unit, base or formation, at least one year of which shall be employment in a senior medical position of that unit, base or formation, or credit will be given for employment at CFIM;
- c. a Diploma in Public Health or Hospital Administration or a Master's Degree in Public Health, Industrial Health, Hospital Administration or Business Administration, or equivalent civilian training and experience in health or business administration;
- d. a minimum of two years service experience as a combatant officer or equivalent, in one of the three operational environments, or successful completion of the Canadian Land Forces Command and Staff College or Canadian Forces Staff College; and
- e. submission and acceptance of a thesis on a subject directly related to Military Medicine, and which has the prior approval of the Surgeon General.

The granting of specialist qualification in Military Medicine by the Canadian Forces Medical Council will be followed by the awarding of a Certificate of Qualification in Military Medicine. This certificate and the individual officer's records will be annotated to show Military Medicine (S), (L), or (A), denoting Sea, Land or Air, as applicable.

Opportunity is also given to obtain DPH, MPH or MIH degrees from recognized universities in Canada and the USA. Occasionally, a Canadian Flight Surgeon has the opportunity to attend the residency course at the USAF School of Aerospace Medicine.

To implement the Aeromedical Training Programme for aircrew and jet passengers, a specialized group of competent, professional officers are necessary. Aeromedical Training Officers are selected from Bioscience officers and must be trained to be all of the following;

- a. instructors;
- b. educators;
- c. programme managers;
- d. active in aviation and associated fields; and
- e. in excellent health physically and mentally;

The aeromedical training officers in the Canadian Armed Forces are essentially drawn from two sources;

- a. university graduates holding degrees in Biology, Physics or related fields. These candidates enter military service directly as a commissioned officer.
- b. experienced Service personnel commissioned from the ranks. These candidates must have a demonstrated ability in Biology, Physics or related fields and formal instruction.

The selected graduate officer thus on entry becomes a Medical Associate Officer with the Biosciences specialty classification but without a task oriented identification. (MAO/Biosc). Depending on his background, he can, on graduation from Common Officers Training, be posted to:

- a. Canadian Forces Institute of Environmental Medicine in Toronto; or
- b. National Defence Medical Centre in Ottawa.

On a quota basis the Bioscience officer is enrolled in a military field medicine course, during his first year of active service.

During his second year of duty he will be selected into a specialty field for which he is best suited. (At this point progress of the MAO/Biosc., commissioned from the ranks into the Aeromedical Training specialty runs parallel to the direct entry graduate officer.) If selected into the aeromedical training specialty field, he will be programmed to attend the following courses as they become available:

- a. USAF, Physiological Training Officers' Course;
- b. USAF, Life Support System Programme;
- c. pedagogy training at the Canadian Forces School of Instructional Technique;
- d. task oriented training at the CFIM;

- e. optional training in Global Survival Concepts;
- f. task oriented training at operational Aeromedical Training Units in the field.

On completion of the listed courses, the MAO/Biosc officer is assigned to the School of Aviation Medicine at the CFIEM, or he is posted to an operational Aeromedical Training Unit at one of the following Commands:

- a. NATO Air Division Europe;
- b. Canadian Forces Training Command;
- c. Canadian Forces Air Transport Command; or
- d. Canadian Forces Air Defence Command.

Once assigned Aeromedical training duties, continuation training is provided as follows:

- a. USAF Physiological Training Symposia;
- b. biosciences symposia conducted by the CFIEM and SAM; and
- c. aerospace medicine conferences.

Appropriate advanced and post graduate upgrading can be applied for in the following categories:

- a. post graduate training in appropriate discipline, applicable to Service requirements.
- b. wing standard flying training, if directly in the interest of the CAF,
- c. CAF Staff School or Staff College training as appropriate,
- d. USAF Training Programmer's Course, and
- e. CAF training supervisor, behavioral writer, or other appropriate advanced training.

A thoroughly trained, highly experienced and valuable officer emerges from this regimen.

Bioscience Technicians for the Canadian Forces are trained at the School of Aviation Medicine. Their duties may be subdivided into four sections:

- a. operational duties;
- b. maintenance duties;
- c. administrative/clerical duties, and
- d. instructional duties.

There are four levels of Bioscience Technician progressing in levels from five to seven and in rank from Corporal to Chief Warrant Officer. Recruits for training as Bioscience Technician normally have a background as a Corporal level five medical assistant but recruits may be accepted from other trades e.g. Safety equipment technician. The School of Aviation Medicine conducts courses for levels five, six, six 8, and seven technicians. Subjects taught in the courses are virtually the same except for differences in emphasis and level of knowledge. The emphasis changes from operational duties through to supervisory and instructional duties from level five to level seven. The level five course is of three months duration consisting of 60 instruction days, 15 of these days are spent on an instructors training course, 15 training days are spent on an instrument training course, five training days are spent on a field visit to an AMTU; the remaining time is spent at CFIEM.

The level six course is of one years duration and is normally commenced immediately on graduation from the level five course. The course consists of a rotating internship through the different departments of the CFIEM for on job training, students are assessed against performance objectives after completing a tour in each department.

The level seven course for Bioscience Technicians consists of 21 training days. In order to qualify for this course, students must be level six Bioscience Technicians with at least 18 months experience.

Teaching in the Bioscience Technician courses is in the areas elicited above. These areas may be further subdivided as follows:

a. Operational duties

- (1) operating of pressure chambers for training, research, and development purposes;
- (2) operating of breathing gas regulating systems.
- (3) operating acceleration and anti-gravity systems;
- (4) fitting anti-buffeting headgear,

- (5) assisting specialist officers in human engineering projects;
- (6) assisting in the development and modification of personal protective emergency and safety equipment;
- (7) operating of recording equipment to obtain physical and physiological data in conjunction with training and research development projects;
- (8) May on a voluntary basis act as a test subject and analyse and report physical and physiological findings; and
- (9) ensuring compliance with orders pertaining to safety precautions and emergency procedures.

b. Maintenance duties

- (1) inspecting and maintaining pressure chambers and associated equipment;
- (2) inspecting and maintaining anti-G suits;
- (3) maintaining and calibrating equipment and instruments used in gathering physical and physiological data;
- (4) conducting of preventive maintenance and permissible repairs;
- (5) ensuring that safety precautions are observed during maintenance; and
- (6) inspecting equipment for serviceability.

c. Administrative/Clerical duties

- (1) performing administrative duties associated with the trade and keeping related records; and
- (2) assisting in inventory control.

d. Instructional duties

- (1) instructing junior tradesmen on the technical aspects of the trade and the medical aspects of survival;
- (2) demonstrating the use of anti-buffeting headgear; and
- (3) assisting in the operation of devices peculiar to the training function of the trade.

In the past, the members of the Flight Safety Officers (FSO) course visited CFIM for a period of two or three days. This period of time has been curtailed because of a reduction in the course length to two weeks, at present the aeromedical input to the course consists of one day of training. An attempt is being made to increase the time available for aeromedical training. The primary purpose of the aeromedical training of Flight Safety Officers is to cross refer to the training of Flight Surgeons and to emphasize that it is essential that the Flight Surgeon, the Flight Safety Officer, the Flight Commanders and the Simulator Operators work as a team in the human factors area of flight safety. Included in the present instruction are the following areas.

- 1. The professional relationship between the Flight Safety Officer and the Flight Surgeon. This section stresses the confidential nature of information that is available to this team and the ethics involved in handling it constructively in the interest of flight safety.
- 2. The signs and symptoms of early stress states. A series of 20 cases are used to illustrate early stress in aircrew and the part played by the FSO in their detection.
- 3. The "accident prone" individual. This concept is discussed historically and practically and advice given concerning the detection of the accident repeater.
- 4. Assessment of human factors contribution to aircraft accidents. The cause factor classifications are examined as applied to actual accidents. The difficulties of interpreting these in the light of normal human capabilities at the time of the emergency are pointed out. The dangers of applying expedient factors such as "pilot error" and "error of judgement" are illustrated. The role of the Flight Surgeon in the investigation of accidents and incidents is also discussed.

Not included in the CFIM presentation are the areas of personal and survival equipment teaching and aviation psychology. These topics are respectively covered by lecturers from other service departments and a guest lecturer from the University of Southern California who covers fear of flying, illustrations, witnesses to accidents and mental stress.

## PART II

Aeromedical Training of aircrew and jet passengers in the Canadian Forces conforms with the recommendations of Stanag 3114. A pilot's first exposure to aeromedical training takes place at the Primary Flying

School where the Flight Surgeon gives two hours of instruction, with emphasis being placed on flying fitness and in-flight stresses related to trapped gases, dysbarism and vestibular function. The 27 hours of flying in single engine piston aircraft received at the Primary Flying School is part of a selection process. The student, therefore, receives just sufficient aeromedical training to make him aware of problems he may encounter in this phase.

Pilots commencing basic flying training and navigators commencing training receive 37 hours exposure to aeromedical training before course commencement. This instruction is reinforced during course training by two hours of lectures from the Flight Surgeon with emphasis on orientation and decompression chamber training type III.

Basic flying training consists of 130 hours on a basic jet trainer followed by advanced training of 100 hours on an advanced jet trainer after which wings are awarded. Pilots are then transferred to operational training units where they are trained on multi-engine, rotary wing, instructional or high performance jet aircraft. At the operational training units, aircrew receive mission-oriented aeromedical training which varies according to aircraft type, mission and environment. This training varies from six to 12 instructional hours. Refresher training is given at least once every three years, more frequently in some Commands. Canadian Forces Minimum requirement calls for a full course consisting of six hours of academic instruction and a hypobaric chamber flight. This training is again mission oriented. Ejection procedure training is given at more frequent intervals varying upwards from 30 days in pilot basic training.

#### SUMMARY OF AEROMEDICAL TRAINING FOR AIRCREW AND JET PASSENGERS

PLACE	COURSE LENGTH	TOPICS
PFS	TWO HOURS	FLYING FITNESS IN-FLIGHT STRESSES - TRAPPED GASES DYSBARISM VESTIBULAR FUNCTION
TRAINING COMMAND	37 HOURS	AS PER STANAG 3114
AMTU		LESS PRACTICAL SURVIVAL
BASIC FLYING SCHOOL	TWO HOURS	ORIENTATION
SURVIVAL SCHOOL	10 DAYS	LAND SURVIVAL - SUMMER BUSH - WINTER BUSH - ARCTIC
OPERATIONAL TRAINING UNIT	SIX-12 HOURS	MISSION ORIENTED PROGRAMMES
AMTU'S		
ALL AMTU'S	SIX HOURS	REFRESHER COURSES AS PER STANAG 3114

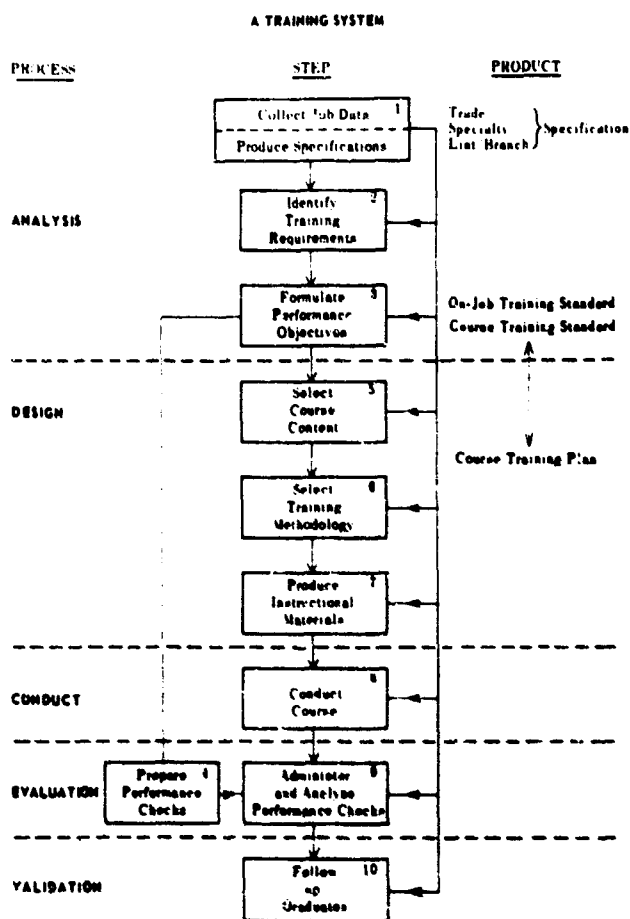
All training in the Canadian Forces is performance oriented. Methods used in training are academic lectures making full use of all available training aids such as slides, films, and tapes. Demonstrations are given making use of simulators e.g. all aircrew have experience in decompression chamber flight, Barany chair demonstration, a static ejection seat systems trainer and a ballistic ejection experience in the Martin Baker tower. Water survival training is received in swimming pools or, at some OTU's, in lakes; the maritime OTU gives survival training in the sea. Other than water survival, the survival training given by AMTU's is academic only. After graduation, aircrew receive survival training at the Canadian Forces Survival School. Examinations in the Canadian Forces training system are also performance oriented, where possible e.g. dealing with hypoxic incidents in the decompression chamber. If academic questions are used they must all be completely relevant, i.e. the student must need to know the information asked for in order to do his job, e.g. he is not asked to define or differentiate between different types of hypoxia; rather, he is asked to describe the vital actions if hypoxia is suspected.

The "closed-loop" integrated training system in use in the Canadian Forces consists of the following steps when applied to Aeromedical Training,

- a. At Canadian Forces Headquarters (CFHQ) a job analysis is made and trade specification (for aircrew) are produced.
- b. At Training Command Headquarters (TCHQ) Course Training Standards (CTS) are prepared from the trade specifications. The CTS contains:

- (1) the intent of the training operation,
  - (2) the expected student performance on course completion,
  - (3) the conditions under which the student must be able to perform e.g. aircraft emergency at altitude,
  - (4) a statement of precisely how well the task must be performed, and
  - (5) a guideline to evaluate student performance at course completion.
- c. At Aeromedical Training Units (AMTU) the most critical document is produced, the Course Training Plan (CTP). This is a Unit document retained by the AMTU and changed to suit performance objectives, the performed task requirements change as missions change. The CTP contains the following directives for instructors:
- (1) lesson specifications and enabling objectives;
    - (a) methodology
    - (b) training aids
    - (c) course time, and
    - (d) tests
  - (2) sequence timing, and
  - (3) skill and knowledge elements.
- d. At TCHQ (Standards Evaluation) standards performance checks are administered by evaluation teams. Students graduating from AMTU's are evaluated.
- e. Finally, user Commands validate the performance of the graduate. Validation findings are submitted to CFHQ and to TCHQ. On the basis of these reports, trade specifications and Course Training Standards are re-assessed and re-written.

The "loop" is now closed producing performance oriented aeromedical training.



At present a great deal of reorganization in the field of aeromedical training is being contemplated in the Canadian Forces. The biggest changes will be seen in the training given by the AMTU's attached to OTU's, this training will become even more objective and mission oriented. A paper on this topic will be read later in this meeting.

The School of Aviation Medicine is at present the only teaching organization in Canada giving aeromedical training. Assistance has been given for some years to private flying clubs, commercial organizations and civilian government departments. Academic lectures and demonstrations are given for the most part, although the advent of high performance jet aircraft in the executive field has increased the demand for decompression training. Since a civilian organization is being formed to give this training, the Canadian Forces Role should diminish.

This paper has described the aeromedical training of personnel in the Canadian Forces who are concerned directly with the operation of aircraft or with the teaching of aeromedical subjects to these personnel. Success in this training programme is achieved through the joint efforts of the Aeromedical Training Units in the field, the Operational Training Units, Training Command, the Canadian Forces Survival School, the Canadian Forces Institute of Environmental Medicine and the School of Aviation Medicine. This system produces aircrew best equipped to meet the challenges presented by the operation of sophisticated complex aerodynamic systems in a hostile environment. The integrity of the military mission depends upon the effectiveness of an aeromedical training programme.

EDUCATION OF THE UNITED STATES AIR FORCE FLIGHT SURGEON

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#### SUMMARY

The Aerospace Medicine Program of the United States Air Force functions to promote and maintain the physical and mental health of Air Force personnel. Flight Surgeons are required at all levels of command to manage and participate in this program. The content and method of teaching various courses at the United States Air Force School of Aerospace Medicine to provide trained physicians for these requirements are presented.

# EDUCATION OF THE UNITED STATES AIR FORCE FLIGHT SURGEON

With each significant advance in aerospace technology the aircrew member has been subjected to an entirely new environment demanding the utmost skill of the flight surgeon for his continual survival. In reviewing the technological advances of just the last half century the aircrew man appears to have been traveling a very narrow path between maximum performance of man and machine and complete catastrophe. In a sense this individual has lived under the constant threat of being overtaken by the machine and overcome by the new environment in which he has been placed. The broadly conceived aerospace medicine program of the United States Air Force, directed by our flight surgeons, was initiated with the principal objective being the continued maintenance of the flyer at the highest possible state of effectiveness under all circumstances. For the past half century the United States Air Force School of Aerospace Medicine has conducted educational programs to provide flight surgeons with the knowledge and ability to accomplish this objective. The mission of the Education Division of the School is much the same as that assigned to the School for Flight Surgeons fifty years ago. Course content and methods of teaching have constantly been modified to meet the changing needs and requirements.

Of the new physicians entering the Air Force each year for their obligated two-year tour of duty, those who volunteer for flight duty are commissioned and ordered directly from civilian status to the School of Aerospace Medicine for a two-week course in basic indoctrination to the military. The principal objective of these two weeks of training is to convert the civilian physician to a military medical officer. Admittedly, this is a short period for such a task; however, this course is followed immediately by nine weeks of study in our Aerospace Medicine Primary Course. Over 13,000 flight surgeons have been trained in this course which has varied in length over the years from as short as eight weeks to as long as six months, depending on requirements. Since most of the physicians trained in this program will return to civilian life at the end of their two-year commitment, we must get them out to field duty as quickly as possible for maximum utilization. Our present nine-week program appears to meet this objective of adequate training balanced against maximum field utilization.

To understand the subject matter of this course, I'd like to review briefly our aerospace medicine program in the United States Air Force. With the specific objective of promotion and maintenance of the physical and mental health of Air Force personnel, this program was conceived to draw together under one functional area all medical and related disciplines required to support flying, missile and space operations; to supervise maintenance of a healthful environment within the entire military community; and to assure safe and healthful working conditions in all military industrial activities. This program at base level must be supervised and managed by the flight surgeon or flight medical officer and is subdivided into three functional areas.

The flight medicine program is specifically dedicated to the anticipation and recognition of medical and environmental problems of the aircrew member and the proper use of available means to prevent or solve these problems. The physical and psychological selection of aircrew members remains one of the primary missions of aerospace medicine. Once selected, the maintenance by periodic examination and observation becomes the primary concern of the flight surgeon. In this manner we hope to promote flying safety and prolong the effective career of the aircrew member. Through regular and frequent flights the flight surgeon is expected to become familiar with the operational aircraft and contribute his knowledge to the requirements for design and development of future aerospace vehicles. The flight surgeon is expected to participate in survival training and is very active in all areas of aeromedical evacuation of patients. He must be completely familiar with all life support equipment and knowledgeable in the physiological changes associated with all flight activity. All air traffic control personnel also come under the supervision of the flight surgeon. In accomplishing these duties we stress a very close association with the assigned crew members in order to know their individual capabilities. Complete knowledge of the operational mission of the units supported is essential for the flight surgeon. He must participate in all flying activities of his unit for intimate knowledge of the environment in which his patients are working.

The health of the aircrew member and his effectiveness in meeting mission objectives are intimately correlated with the health and effectiveness of the entire community. For this reason the military public health program concerns itself with all aspects of the environment of an operational air base. This portion of the program is intimately concerned with the maintenance of adequate immunizations and the epidemiology of disease. A healthy, well-adjusted family unit plays a major role in the effectiveness of the aircrew member. For this reason family care is stressed as a portion of the flight surgeon's duties. Constant surveillance of the working environment by the flight surgeon ensures the healthiest possible personnel to maintain our aerospace vehicles for mission accomplishment. This is the objective of the occupational medicine program.

The Aerospace Medicine Primary Course is specifically designed to train our base level flight medical officers who will supervise the program as described above. Since this constitutes the bulk of our workload and probably represents your primary interests, I would like to present a detailed picture of the course content. During the nine weeks of instruction the course contains approximately 368 hours broken down into major sub-headings as follows:

	<u>HOURS</u>	<u>CUM. TOTAL</u>
Aerospace Medicine	133	133
ENT	29	162
Aerospace Physiology	20	182
Oxygen Equipment	4	186
Altitude Indoctrination	8	194
Aircraft Escape	11	205
Ophthalmology	41	246
Preventive Medicine	47	293
Exercise Physiology	26	319
Internal Medicine	14	333
Psychiatry	7	340
Neurology	2	342
Administrative Time	26	368

From this outline you will see that the block of instruction entitled "Aerospace Medicine" makes up slightly more than one-third of the total program. It is here that we teach administrative management of the aircrew member insofar as his health and welfare is concerned. The following breakdown of this large block of instruction will illustrate the areas of interest:

	<u>HOURS</u>
1. Introduction (Introduction to Course, History of Aerospace Medicine, What is a Flight Surgeon?)	3
2. Physical Standards & Medical Examinations	11
3. Aerospace Medicine Management Practices	11
4. Clinical Aerospace Medicine	11
5. Physical Fitness & Aircrew Conditioning	2
6. Aerospace Safety & Accident Investigation	22
7. Disaster Defense Training	6
8. Flight Principles & Human Factors in Aircraft Systems & Operations	21
9. Air Warfare Operations	12
10. Major Command Briefings	6
11. Aeromedical Evacuation	6
12. Survival	14
13. Other Aspects of Aerospace Medicine	8
Total	133

You will note from this outline the large block of 21 hours on flight principles. We have found through experience that the physician who knows the machines that his patients will fly will become much better acquainted with the aircrew members in a shorter period of time and will have a much better idea of the problems encountered in flight. In other words, a better rapport is established at an earlier date. Another large block of hours here is devoted to aerospace safety and accident investigation. I will discuss the technique of teaching this later. These base level flight surgeons are in most instances the first physicians to arrive at an accident scene; and we are completely dependent upon them for collection of all statistics utilized in our safety programs, equipment modification and other material used in devising our safety programs. They must be thoroughly grounded in accident investigation techniques or the statistics that we collect are completely worthless.

The next largest block of hours taught are those of the clinical medicine subjects that are our biggest concern in the flight environment. A total of 93 hours are taught in these subjects as follows:

<u>ENT</u>	<u>HOURS</u>
1. Clinical Aeromedical ENT	13
2. Vestibular Function & Dysfunction	7
3. Audiology	9
	29

<u>OPHTHALMOLOGY</u>		<u>HOURS</u>
1. Introduction to Aerospace Ophthalmology		1
2. Basic Science		11
3. Clinical Ophthalmology		6
4. Practical Application		16
5. Special Considerations in Aerospace Ophthalmology		<u>7</u>
		41
<u>INTERNAL MEDICINE</u>		
1. Cardiology		9
2. Hypertension		1
3. Hematology		1
4. Syncope		1
5. Pulmonary Disease		1
6. Gastrointestinal Disease		<u>1</u>
		14
<u>PSYCHIATRY</u>		
1. Personality Structure of Flyers and Missileers		1
2. Special Operational Stress		2
3. Forensic Psychiatry		1
4. Selection and Disposition		2
5. Minor Psychiatric Problems of Aeromedical Importance		<u>1</u>
		7
<u>NEUROLOGY</u>		
1. Neurologic Problems in Aerospace Medicine		2

Primary interest areas here, as you see, are otolaryngology, ophthalmology, internal medicine, and psychiatry. Most of the instruction in otolaryngology and ophthalmology is conducted in rotational sessions where the class is divided into smaller groups for individual attention in examining techniques and the practical application of knowledge acquired both in this course and in medical schools. The hours on internal medicine, psychiatry, and neurology are all conducted as lecture presentations as we do not have the time nor the patient load available for individual case studies. All of these lectures stress the aeromedical implications of the various conditions rather than discussing specific disease processes.

A block of 43 hours is devoted to aerospace physiology, altitude indoctrination and emergency escape from aircraft. A detailed breakdown of this block is as follows:

<u>AEROSPACE PHYSIOLOGY</u>		<u>HOURS</u>
1. The USAF Physiological Training Program		1
2. Physics of the Atmosphere		1
3. Respiration and Circulation		1
4. Hypoxia		2
5. Hyperventilation		1
6. Pressure Breathing		1
7. Thermal Problems in Aircraft Operations		1
8. Acceleration		2
9. Medical Management of Decompression Sickness		2
10. Decompression Sickness Problems		2
11. Hyperbaric Physiology		2
12. Cabin Pressurization		2
13. Physiological Incidents		1
14. Personal Equipment		<u>1</u>
		20
<u>OXYGEN EQUIPMENT</u>		
1. Oxygen Equipment		4
<u>ALTITUDE INDOCTRINATION</u>		
1. Low Altitude Indoctrination		4
2. High Altitude Indoctrination		<u>4</u>
		8
<u>AIRCRAFT ESCAPE</u>		
1. Emergency Escape from High Performance Aircraft		2
2. Practical Methods of Instruction in Parachuting		1

<u>AIRCRAFT ESCAPE (Cont'd)</u>		<u>HOURS</u>
3.	Ejection Seat Training	4
4.	Parachute Descent and Landing Techniques	4
		<u>11</u>

The flight surgeon must be completely familiar with the physiological problems of flight at altitude not only for his own benefit in flight, but for the purpose of instructing aircrew personnel in these areas. You will notice in the aerospace physiology that decompression sickness and hyperbaric physiology are included. We now have eight locations throughout the world where hyperbaric chambers are available for the therapy of decompression sickness. Those physicians going to these locations are retained at the School of Aerospace Medicine for an additional two weeks for a course in hyperbaric medicine. All students are given indoctrination in the altitude chamber that includes an emergency decompression to extreme altitude where pressure breathing equipment must be utilized. Each student is given an opportunity to ride our ejection seat trainer that Dr. Dunn will discuss later in the program. In small rotational groups, all students are taught the proper methods for parachute descent and landing techniques.

In teaching this large class every effort is made to keep didactic classroom lectures to a minimum and utilize the technique of small rotational groups to provide a more intimate instructor-student relationship. All visual aids are utilized. Closed circuit television has been an excellent adjunct in our teaching program. This has been especially useful in presenting detailed data such as the various administrative forms that are required for management of the aerospace medicine program. We try to avoid the "talking-face" type presentation on television; however, we do have an excellent file of television tapes that can be used when specific instructors are not available. As an example, we completed an excellent color television presentation of Dr. Hubertus Strughold's lecture on the physiological clock. A recent innovation has been the use of mock-ups for the teaching of aircraft accident investigation. Here, an old aircraft fuselage is used for simulated aircraft accidents, and moulages and theatrical makeup are used to simulate casualties. Actual case files of accidents are used as a protocol, and malfunctions of life support equipment are placed on the casualties or portions of the aircraft or ejection seats. Students are required to investigate this mock setup and report their findings. This also reinforces our teaching of the management of mass casualty situations.

After one year of field duty as a flight medical officer, the physician may enter our Aerospace Medicine Residency training program. This residency is a three-year program, the first year being conducted at a recognized school of public health where the student earns a Master's Degree in Public Health. The second year is conducted at the School of Aerospace Medicine, and the third year is spent at an established training site under the preceptorship of a board-certified specialist in aerospace medicine. This program was designed to provide career flight surgeons in the Air Force with the training needed to supervise the entire aerospace medicine program from a staff and command level.

During the first year we encourage the students to get as much training as possible in community health programs such as the epidemiology of disease, public health administration, and environmental health. They also get good background education in medical statistics.

The second year at the School of Aerospace Medicine involves an in-depth study of all of the subjects previously described for the Primary Course. In addition, these physicians are given approximately 20 hours of pilot training in our primary jet trainer. They are taken through the jet qualification protocol up to solo flight. We do have a few of our residents who have qualified for and been allowed to take the full year's training as pilots and awarded the rating of pilot-physicians. This flight training gives the resident first-hand knowledge of the stresses of learning to fly a high-performance aircraft and makes him a much more valuable member of the aerospace team. Eight weeks are spent on the consultation service managing patients referred from all over the Air Force for problem situations that could not be resolved at base level. Here the resident is given an in-depth study of the aeromedical implications of all the medical conditions that plague the aircrew member. He is required to evaluate these patients, present his findings to the senior medical staff, and recommend the course of action for the solution of the problems. During the second year the entire residency class attends the one-week arctic survival course conducted at Eielson Air Force Base in Alaska and the one-week tropical survival course conducted at Albrook Air Force Base in Panama. Several other field trips are made for the purpose of obtaining first-hand knowledge of the conduct of the aerospace medicine program in our various major air command headquarters. We also enjoy very much a visit to the Canadian Institute of Environmental Medicine in Toronto, Canada, and brief visits to both the Army's aviation

school and the U.S. Navy Institute of Aerospace Medicine. Each resident is required to complete a basic research project involving the collection and analysis of data obtained from original research. Evaluation of the resident's progress is accomplished through oral examinations conducted by senior specialists in the field of aerospace medicine at periodic intervals during the year.

During the third year of the formal training program the resident is assigned to a surgeon's office at one of our major air commands or to other training sites where broad coverage of the aerospace medicine program can be studied under the preceptorship of a senior specialist. This provides a twelve-month period of practical application of all the training in a close personal relationship with well qualified supervisors.

Each year personnel from the Education Division of the School of Aerospace Medicine visit many bases throughout the Air Force to evaluate the results of our training programs. It is during these visits that we review the requirements of our major air command and operational base units. Personal contact is made with graduates of all of our training programs, and we obtain the frank evaluation of each course from former students who have been practicing in this specialty for varying periods of time. The results of these visits are used to modify or revise course content and teaching methods. This has proved to be an extremely valuable management tool in our educational mission. It allows us to constantly update, modify, or revise programs to meet operational requirements.

I have described briefly two of our programs for the education of the United States Air Force Flight Surgeon. A detailed breakdown of course content and method of teaching the Aerospace Medicine Primary Course has been presented. I do not wish to imply that this is a static, fixed course of instruction. Basically, this course will remain as I have presented it. But as our mission and operational requirements change frequently, we sincerely hope to remain flexible enough so that our flight surgeon graduates will continue to support the aircrew member in whatever environmental situation he may find himself.

AVIATION MEDICINE TRAINING PROGRAMS IN THE U.S. ARMY

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## S U M M A R Y

## AVIATION MEDICINE TRAINING PROGRAMS IN THE U.S. ARMY

a. Basic Army Flight Surgeon Training Program - A discussion of the Army basic course in Aviation Medicine, to include training objectives, scope of curriculum, and course content. Particular emphasis will be placed upon methodology of instruction and utilization of newer teaching techniques and aids, which include in-house educational television productions, specialized training aids and programmed instruction.

b. Intermediate and Specialized Army Aviation Medicine Training Programs

(1) A discussion of courses offered to recent Army graduates of either Air Force or Navy primary training programs.

(2) A discussion of a specialty orientation course offered to senior medical department personnel to acquaint them with Army Aviation and Army Aviation Medicine.

c. Advanced Army Aviation Medicine Training Program - A discussion of the Army participation in the Aerospace Medicine Residency Training Program. Particular emphasis placed upon Phase III training which is conducted at Fort Rucker, Alabama. Program objectives and course content will be presented along with resident responsibilities.

d. Physiological Training Programs for Army Flying Personnel - A discussion of physiological training for Army aviators will be presented. This will include both general subject areas and specialized physiology training for selected aircraft aircrews.

Fort Rucker is the home of the Army Aviation Center and Aviation School, located in the south-eastern section of Alabama in an area where good weather prevails the great majority of the time and is ideally suited for aviation training.

The Army Aviation School has the mission to train aviators, mechanics, and other aviation specialists.

During the fiscal year 1969, 7785 initial entry rotary wing (7170) and fixed wing (615) Army aviators were trained, which represents a 300-man graduating class every two weeks. In addition to pilot training, numerous officer and enlisted specialty training programs are conducted, which include air traffic controllers, maintenance personnel, warrant officer career programs and flight surgeon programs.

#### Aeromedical Training and Services

Aeromedical training and aeromedical services which are the subject of this paper include:-

a. Basic Army Flight Surgeon Training Program. The Army's basic course in aviation medicine, training objectives, scope of curriculum, and course content. Particular emphasis will be placed upon methodology of instruction and utilization of newer teaching techniques and aids, which include in-house educational television productions, specialized training aids and programmed instruction.

b. Intermediate and Specialized Army Aviation Medicine Training Programs

(1) Courses offered to recent Army graduates of either Air Force or Navy primary training programs.

(2) A specialty orientation course offered to senior medical department personnel to acquaint them with Army aviation and Army aviation medicine.

c. The Advanced Army Aviation Medicine Training Program - the Army's participation in the Aerospace Medicine Residency Training Program, with particular emphasis upon Phase III training which is conducted at Fort Rucker, Alabama. Program objectives and course content will be presented along with resident responsibilities.

d. Physiological Training Programs for Army Flying Personnel, including both general subject areas and specialized physiology training for selected aircraft aircrews.

e. The Army Aeromedical Consultation Service, an educational and research aspect of the Phase III Aerospace Medicine Residency Program.

#### Department of Aeromedical Education and Training (DAET)

The Department of Aeromedical Education and Training, U.S. Army Aviation School, Fort Rucker, Alabama, has the overall mission to advise the Commanding General of the U.S. Army Aviation School on all matters pertaining to aeromedical education and training. In brief, to be responsible for the Army Aviation Medicine Training Program. Historically, prior to 1963 the Army depended upon the Air Force and Navy to train its flight surgeons. As Army aviation began to expand in the early 1960's, primarily as a result of Vietnam, the need for medical support personnel also increased. It became apparent that to continue to rely on the Air Force and Navy training programs for our graduate flight surgeons was both uneconomical and impractical, due to the projected numbers involved. Therefore, in 1963 Department of the Army directed that the U.S. Army Aviation School begin an in-house Army flight surgeon training program to meet the medical support demands of an expanding Army aviation program.

To implement this new mission, the Department of Aeromedical Education and Training was organized as a department in the Aviation School in 1964 and has continuously functioned at a department level since the inception date. Internally, DAET is organized into a Professional Education Division and a Technical Training Division and has a staff of five officers, six enlisted and two civilians.

#### Basic Army Flight Surgeon Training Program

This program is the U.S. Army's 7-week basic course in aviation medicine that is conducted by the Department of Aeromedical Education and Training of the U.S. Army Aviation School. The program was developed by taking the syllabi of the Air Force and Navy courses and eliminating areas such as specific administrative procedures, regulations, and problems of high altitude and high performance flying which are not pertinent to the practice of Army aviation medicine. Although this course was initially developed as an expedient to meet the medical support requirements for the rapid growth of Army aviation, it has proved to be an intensified course in aviation medicine. Following successful completion of this course, the graduate is given his wings and assigned to an aviation unit as its flight surgeon.

The major portion of the course is spent in increasing the prospective flight surgeon's medical education in matters relating to the aviation environment. Other subject matter included in the course is as follows:-

- a. Basic physics of the atmosphere.
- b. Physiology of respiration.
- c. Physical effects of the lack of oxygen.

- d. Physical effects of altitude.
- e. Basic Army oxygen systems.
- f. Altitude chamber qualifications.
- g. An experience in the Martin-Baker ejection seat simulator.
- h. Examination and function of the eyes and ears, particularly with regard to disorientation and visual disturbances.
- i. Heart and blood vessels as they pertain to function in the aviation environment.
- j. Acceleration and G-forces, with emphasis on their application to aircraft accident investigation.
- k. Human factors, pathology, and toxicology, with emphasis on their application to aircraft accident investigation.
- l. Professional role of the physician in aeromedical evacuation, with emphasis on proper selection and preparation of patients for air movement.
- m. Stress and fatigue, survival, escape and evasion.
- n. Flight surgeon's role in the physical examination and selection of the aviator, along with direct medical treatment of the aviator.
- o. Introductory training in weather, navigation and aircraft systems.
- p. Link training at the controls of the Army's basic aircraft to become familiar with the machines his future patients will operate.
- q. Approximately 10 hours of airplane and 10 hours of helicopter flight orientation instruction.

#### Basic Army Aviation Medical Officers' Orientation Course (BAAMDOC) Curriculum

This basic course is conducted six times a year with an enrollment of up to 30 students per class. The Army's basic course in aviation medicine began in 1963 as a 3-week, 4-day crash course to meet the medical needs of an expanding Army aviation program. Over the past five years the course has had numerous revisions and lengthening, until at present it is a 7-week course. The course has been highly oriented to Southeast Asia, but not to the extent of comprising other facets of aviation medicine training.

Over the past few years the department has had an opportunity to refine and upgrade the entire curriculum. Currently all our instructors are MDI graduates and have as their primary mission education and training. We are utilizing educational TV and this year produced in-house four television clips with eight more in production, relating to material taught in the basic course. We have just completed an Army Flight Surgeon's Manual of over 1200 pages, which will serve as a textbook for the basic course, as well as a reference manual for the man in the field. In the area of quality control, in addition to the end-of-course critique, we go to the field six months after graduation for a follow-up critique. We rely heavily on the 6 month critique because we find them much more valuable than the end-of-course critique for significant contributions to improving the course.

The training program has graduated the following totals of Aviation Medical Officers:-

<u>Fiscal Year</u>	<u>Number</u>
1960	30
1961	28
1962	60
1963	72
1964	60
1965	88
1966	180
1967	85
1968	142
1969	175

A small select number of Army medical officers may attend one of the following two courses - The first program is the U.S. Air Force 9-week primary course in aviation medicine that is conducted at the U.S. Air Force School of Aerospace Medicine, Brooks AFB, Texas. Following the successful completion of this course, he will be sent to the U.S. Army Aviation School, Fort Rucker, Alabama, to attend a 2 1/2-week Army aviation medicine orientation course. This is designed to reorient the individual in terms of Army aviation medical policy, procedure, facilities and philosophy. The total training program covers about 11 weeks, and is designed to reorient the newly-trained flight surgeon to the Army's aeromedical way of life.

#### Army Flight Surgeon Designations and Incentives

Without wishing to argue existing philosophies, it may be said with a considerable degree of truth, that when most people think about motivation they are frequently thinking about money or tangible rewards. It is in this area that the categories of designation and incentives fall.

Upon successful completion of the basic course in aviation medicine, and this may be either the USAF, USN, or USA program, the individual receives the designation "Aviation Medical Officer", the military occupational specialty D3160, the basic aviation medical officer's wings. He may be placed on non-crewmember flight status and receive flight pay amounting to \$110 per month. In order to continue to receive the non-crewmember flight pay, the aviation medical officer must fly four hours per month.

### Flight Surgeon

After practicing as an Aviation Medical Officer for one year and having logged 100 hours of flying time, the individual may receive the designation "Flight Surgeon" (his military occupational specialty 03160 remains the same), the flight surgeon's wings, and crewmember flight status. Crewmember flight pay for the usual medical officer amounts to approximately \$185 per month, but it is on a graded scale and will vary with rank and active duty time. In order to remain on crewmember flight status, the flight surgeon must fly a total of 80 hours per year with 20 hours of cross-country time and 15 hours of night time, of which 5 will be night cross-country. This minimum flight requirement is, with minor exceptions, the same as is required of the Army aviator.

### Senior Flight Surgeon

After seven years in the practice of aviation medicine and 700 hours of flying time, the flight surgeon may apply for a change in designation to "Senior Flight Surgeon". His military occupational specialty remains the same. He receives the SFS wings and his crewmember flying status continues.

For those officers who enter and complete the formal residency training program and receive their certification by the American Board of Aerospace Medicine, the designation and incentives remain essentially the same except for the military occupational specialty. Upon completion of the formal three years of residency, the flight surgeon is considered board eligible with an MOS of C3160. Upon board certification, the flight surgeon is given the MOS B3160. The military occupational specialty of A3160 is awarded by The Surgeon General and denotes professorship status or national prominence in the field.

### Army Flight Surgeon Assignment and Utilization

Army aviation medical officer/flight surgeon strength at the end of fiscal year 1969 was approximately 325. This included all personnel with MOS 3160, without regard to prefix. In terms of assignment and utilization, there are four major levels at which Army aviation medical officers/flight surgeons are assigned:-

a. After completing the basic aviation medical training, the unit level flight surgeon can be assigned to a military installation as the post flight surgeon or to an aviation unit as the unit's flight surgeon. When assigned as the post flight surgeon, he will be working for the hospital commander; when assigned as the unit's flight surgeon, he will be working for the unit line commander. From the standpoint of the ability to practice aviation medicine, the aviation unit is usually the more acceptable organizational structure. This category represents approximately 55 per cent of medical corps officers with the MOS 3160.

b. The second category of utilization is that of staff command. These are Army flight surgeons who are assigned at staff command levels such as division (division surgeons), brigade, major Army commands (both in CONUS and overseas), and DA level (e.g., Office of the Surgeon General). These flight surgeons have primarily medical administrative responsibility and practice aviation medicine as a secondary duty. This category represents approximately 7 per cent of medical corps officers with the MOS 3160.

c. The third category of utilization are those flight surgeons assigned in a consultant category. This group consists of Army flight surgeons who have received basic aviation medicine training, but have also been trained in one of the clinical specialties. They lend depth to the aviation medicine program. Aviation medicine is a horizontal specialty, and the flight surgeon receives considerable, but not complete, training in each of the clinical specialties. The needed depth for consultation required by the flight surgeon in many of the clinical specialties is provided by this group. This consultant category fills a significant need. There are many installations at which Army aviators may be assigned in insufficient numbers to justify the assignment of a full-time flight surgeon, but one of the clinical specialists assigned to that installation can be trained basically in aviation medicine. This category represents approximately 13 per cent of medical corps officers with the MOS 3160.

d. The fourth category of utilization is that of the specialty of aviation medicine. These are individuals who have either completed or are in the residency program. This category represents approximately 10 per cent of medical corps officers with the MOS 3160.

e. A fifth group comprising approximately 15 per cent of medical corps officers with the MOS 3160 are those no longer active in the field of aviation medicine. This group contains mostly senior officers or those individuals who have entered clinical residency after serving as unit flight surgeon.

Current employment may be summarized as follows:

Unit level	190
Staff and Command	29
Consultant	63
Specialty	43
	<hr/>
	325

As a result of the rapid growth of Army aviation, and the present requirements to provide adequate medical support for Army aviation, there is an existing need for approximately 150 flight surgeons.

#### The Preventive Medicine Program

1. After practicing aviation medicine in the field for one year, the flight surgeon desires to make a career of aviation medicine, he can apply to the Office of The Surgeon General for residency training in Aerospace Medicine, a 4-year program which leads to specialty certification in this field. Aviation medicine has been a recognized medical specialty since 1953, when the certification of specialists was begun by the American Board of Preventive Medicine in aviation medicine. The Army does not have a complete residency program. Army flight surgeons undergo training in programs conducted by either the Air Force or the Navy. Both programs are similar in content. The resident's first year is spent at a civilian university. Most residents choose the University of California, Harvard, or the Johns Hopkins Schools of Public Health. During this year, the flight surgeon is required to meet his flight minimums by flying nights and weekends at any nearby military aviation facility. At the end of an academic year covering such subjects as administration, preventive medicine, industrial and occupational health, and the traditional field of public health, the physician is awarded the postdoctoral degree of Master of Public Health. During the second year, the flight surgeon attends at the U.S. Air Force School of Aerospace Medicine, San Antonio, Texas, a course which includes:-

- a. Intensive and thorough training in the basic responses of the human body to the flight environment.
- b. Aviation physiology, including the effects of temperature, pressure, atmospheric components, acceleration, and life support in closed systems such as space cabins.
- c. Recognition, prevention, and treatment of aviation related disorders, including the environmental hazards, both physical and psychological, faced by aviation and ground support personnel.
- d. Aircrew selection procedures and the evaluation of aviators for return to flight status following disease or injury on both an academic and practical level.
- e. Travel in the School of Aerospace Medicine's KC-97. The flight surgeons spend about one-third of their time away from San Antonio. There are scientific visits to United States and Canadian Aeromedical facilities; aerospace industry orientation; missile medicine experience at Vandenberg AFB; and briefings at Headquarters, Strategic Air Command, and Military Airlift Command.
- f. Training courses in jungle and arctic survival at Albrook AFB, Panama, Canal Zone, and Eielson AFB near Fairbanks, Alaska.
- g. A 5-week period in flight familiarization in the T-37A, a twin-jet trainer. Flights include VFR, IFR, formation, night and cross-country experience.
- h. Weather, navigation, and aircraft systems familiarization.
- i. At least five oral examinations, given by experienced specialists in aerospace medicine, covering each phase of the flight surgeon's training. The last of these is a "murder board" of at least six examiners, covering the entire year's work.

The third year of residency is spent at an approved affiliated training site under the guidance of a flight surgeon who is certified by the American Board of Preventive Medicine in aviation medicine. Army residents serve this year at the U.S. Army Aviation Center, Fort Rucker, Alabama, or at selected Air Force sites. During this year, the resident practices, under supervision, the clinical, preventive, educational, training, and research and development phases of aviation medicine. Within these phases, he is given authority commensurate with his responsibilities. In order to meet the requirements for board certification, the resident must spend one year in the practice of aviation medicine in addition to the three years of formal residency. At the present time, the one year (or any increment of it) may be spent either before or after his completion of the three years formal residency.

#### Specialized Aviation Medicine Training Programs. (Technical Training Division)

The technical training division is responsible for the specialized and physiological training activities of the department. In the specialized category we offer a 1-week course to senior medical service officers four times a year. This is an orientation type of course which introduces these people to Army aviation and the Army aviation medicine program. During the course the attendees will be exposed to all major activities at the Aviation School and will be provided an opportunity to see aviation at work.

The Army currently has about 20,000 individuals on flying status, the majority the younger warrant officer (12,000). Additionally, it has in the neighborhood of 13,000 aircraft of both fixed wing and rotary wing types. All Army aviators are receiving physiological training of one kind or another.

Specifically, aviators attending the courses relevant to the U-21, OV-1 and C-8 aircraft, which are capable of flight in excess of 15,000 feet and accelerations of +6G to -3G, receive high altitude

indoctrination which includes a low pressure chamber orientation conducted at the Naval Air Station, Pensacola, Florida. Plans are underway to procure a low pressure chamber for the Army Aviation Center and for the Army to conduct its own training in these areas in the near future. The Army is fortunate to have assigned a school trained physiological training officer who is currently revamping and expanding our programs in these areas. Projects are currently underway for high altitude indoctrination, night vision training, disorientation training, and a host of related activities.

The Army aviator has been sorely neglected in the area of physiological and aviation medicine support, mainly because of a lack of qualified and interested flight surgeons in the past. This is rapidly changing and attitudes toward this training are becoming more acceptable by the line officer aviator, and the Army is developing a staff of residency trained career oriented flight surgeons. A new course which is awaiting final DA approval is the Aeromedical Specialist Course. This will be a course for the enlisted medical technician which will prepare him to become the flight surgeon's assistant. Approval for this course is expected in the near future.

#### The Aeromedical Consultation Service

The Army Aeromedical Consultation Service provides a unique service to Army aviation. It is the responsibility of the Phase III resident during his rotation at DAET, and provides the resident an opportunity to apply his knowledge and a learning and research experience in dealing with multiple unique cases.

The Consultation Service applies only to rated Army aviators whose physical condition following hospitalization for injuries precludes their meeting the usual class 2 flying standards. In some cases a waiver is necessary to allow retention on active duty. This service does not apply to those aviators who are found unqualified for flying during conduct of a routine flight physical or medical consultation. It is meant to benefit those aviators who have recovered from injuries and who, in the opinion of unit flight surgeons, still possess motivation and some capability for flying, even with possible restrictions regarding type of duty, type of aircraft, assignments, number of hours flying, etc.

It is hoped that when rated aviators receive surgical evaluation from any military surgeon, they will be informed of the possibility of such an inflight evaluation. For the vast majority of these well-motivated men, this would be a tremendous factor stimulating a more prompt rehabilitation phase. How may an inflight evaluation of an injured Army aviator be accomplished? The unit flight surgeon gives the initial appraisal of the aviator. If he feels that the pilot still possesses some capability for flying duty and is well-motivated, the request for flying duty and medical documentation of the case are then sent to the local medical commander. The commander refers appropriate cases to The Surgeon General. The Surgeon General determines the necessity for medical evaluation. He then coordinates with the Chief, Personnel Operations and the basic branch of the individual flier. The Surgeon General then coordinates with the United States Army Aviation School, Fort Rucker, Alabama, for actual scheduling of the inflight evaluation.

This aeromedical consultation/inflight evaluation is a comprehensive medical and surgical evaluation as well as actual inflight appraisal of the recovered injured aviator. It is conducted by the Aeromedical Consultation Service, Department of Aeromedical Education and Training, U.S. Army Aviation School. Appropriate consultations, laboratory and X-ray studies are then taken to fully understand and appreciate the entire medical problem.

After this workup has been completed and results appear satisfactory to all concerned, the inflight evaluation is actually begun. During the evaluation the aviator, a selected instructor pilot, and a flight surgeon will fly in all aircraft in which the injured aviator had been previously rated. The evaluation is meant to check, in actual aircraft, the aviator's reaction time to physical inflight requirements and stresses in light of his physical impairment. The aviator will be required to demonstrate his ability to perform safely all normal functions associated with piloting and preflighting the aircraft.

The instructor pilot will provide the Department of Aeromedical Education and Training at the Aviation School a complete report regarding performance, capabilities and/or limitations of the aviator in each type of aircraft flown.

The medical consultation and inflight capabilities are evaluated by a consultant board of flight surgeons and a qualified instructor pilot. The conclusions and recommendations are reviewed by The Surgeon General and forwarded to the Chief, Personnel Operations. Here, the final determination is made regarding flying status in each case along with the recommendation for restrictions, if any. Experience of the consultation service includes evaluation of 84 cases since 1960, among which were 8 amputees and 6 ocular cases.

Based upon a training cost figure of around \$50,000 per man, it is conservatively estimated that the Consultation Service has resulted in a training dollar saving of about 2.9 million dollars.

#### SUMMARY

In summary, the Aviation Medicine Training Program of the Army initially trains the physician to cope with the unique medical problems generated by the aviation environment. Additional training in the formal Aerospace Medicine Residency Program broadens the flight surgeon's knowledge of medicine as it applies to the support of military aviation. The flight surgeon functions at the aviation unit level, the staff and command level, as a consultant, or within the specialty of aerospace medicine itself. Within these basic areas of responsibility, the flight surgeon performs physical examinations on flying personnel; provides clinical care for the pilot and his dependents; provides an active preventive medicine program; offers staff advice on aeromedical matters; and participates in research, development, education and training. Thus, by attempting to ensure a safe occupational environment and to preserve the aviator's health, the flight surgeon can actively contribute to the overall success of the Army aviation mission.

AVIATION MEDICINE TRAINING IN THE ROYAL AIR FORCE

by

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#### SUMMARY

The historical development of training in aviation medicine in the Royal Air Force is briefly described. The present situation is outlined and possible weaknesses indicated along with suggestions for improvement.

It is my task to introduce British views in general terms, for I am to be followed by other speakers who will examine specialised aspects in more detail.

First a definition - aviation medicine may be considered as the environmental or occupational medicine of flight. This has both clinical and non-clinical aspects, and as teaching of the clinical aspects is largely, if not exclusively, a matter for clinicians, what I will say will refer particularly to non-clinical aspects.

Just as technology has developed fastest in wartime so has aviation medicine, and the military need for new information has initiated much effort both in research and in the practice of aviation medicine.

In the United Kingdom there has always been a somewhat pragmatic approach to matters of this kind and the teaching of aviation medicine is no exception. In the 1914-1918 war the emphasis was on selection of aircrew. The Medical Officer was largely left to his own devices and dealt principally with morale, medical fitness and accidents. As hostilities developed so did interest in such other matters as oxygen equipment, and the book written by W. G. Anderson, a Medical Officer of the Royal Navy, in 1919 has chapter headings not altogether unrepresentative of a modern instructional course, despite the obsolescence of some of its material.

In the interwar years lessons learned in conflict were largely forgotten and the concept of the Medical Officer as an all-rounder persisted. This was reinforced by the knowledge that any doctor who was fit, willing and able could be trained to fly and thus get a direct insight into the stresses experienced. This is how matters stood at the start of the war of 1939-45.

Very shortly before this war the Royal Air Force physiological laboratory (in 1945 its name was changed to the Royal Air Force Institute of Aviation Medicine) had been formed at Farnborough within the Royal Aircraft Establishment and the nucleus of a cadre of research workers came together. From this laboratory's earliest days teaching was one of its responsibilities. The staff gave lectures to both Medical Officers and aircrew, and indoctrinated aircrew in the use of new systems of personal and survival equipment. The subjects taught related to practical service problems, oxygen lack, black out, survival and rescue, instrument illumination, night vision, effects of cold, and so forth. Courses never lasted more than one week. Two contemporary factors were of much importance; firstly, the appointment of Flying Personnel Medical Officers, principally from those who had been taught to fly before the war, with responsibility, inter alia, for aeromedical training in their Commands; and secondly, the use of mobile decompression chambers for indoctrination of aircrew in the use of oxygen equipment, and for decompression testing. These chambers were run by Medical Officers who had usually been given some additional training. Other special devices such as night vision trainers were used also. However, to summarise the war period, training, both of Medical Officers and aircrew, though often intensive, was yet irregular and without a master plan; consequently many officers had no systematic training.

After the war there was a period of run down. There was a reduction in the number of courses, but one or two spasmodic efforts were made to hold longer and more advanced courses. Here I should like to mention the two aspects of aeromedical training - training of Medical Officers and that of aircrew; these are separate matters yet the latter depends heavily on the former.

With the introduction of large quantities of pressure garments and pressure breathing equipment the task of aircrew indoctrination became too great for the Royal Air Force Institute of Aviation Medicine, and in 1960 the Aeromedical Training Centre was set up at Royal Air Force Station Upwood for this purpose, about which you are to hear later.

With regard to Medical Officers, the Flying Personnel Medical Officer concept had been retained and up to 1965 there was a total service establishment of 19 of them, but two disadvantages were becoming apparent - the officers themselves had been given no systematic training in Aviation Medicine, and there was some difficulty in their retaining proficiency of flying skills due to difficulty of access to aircraft, whose cost was increasing steeply. Their number has now been reduced to five. Incidentally they are now called simply Medical Officer (Pilots).

It was acknowledged, as part of an extensive review of aviation medicine in the Royal Air Force in 1966, that aeromedical training of Medical Officers was inadequate and that some steps were required to improve matters. On the service side a specialty in aviation medicine was set up (hitherto the specialty of aviation physiology had existed predominantly to support research), a professor in aviation medicine was appointed and a category of Flight Medical Officer was created. From this course of training a diploma in aviation medicine was developed with the Conjoint Board of the Royal College of Physicians, London and the Royal College of Surgeons, England as examining authority. The Royal Air Force Institute of Aviation Medicine is the teaching authority, but it is helped considerably by clinical consultant staff of the Royal Air Force and by medical officers of the Air Corporations Joint Medical Service, the Board of Trade and others.

You will hear more of the Diploma course from another speaker later on. Sufficient to say here that it is an open course designed to give medical officers from whatever source a systematic grounding in both civilian and military aspects of aviation medicine. Its usefulness for service officers is

reduced by the exclusion of classified material and certain specialised matters related to specific equipment in use in the service. It is, however, an important corner stone on which a sound aero-medical educational system for the services can be built.

A good training system depends on the availability of suitable books. The Royal Air Force's principal effort in this sphere is the Textbook of Aviation Physiology published in 1965. This is, however, a highly specialised book primarily for the research worker and it does not cover all aspects of aviation medicine included in the diploma course.

At the present time other shorter courses are run also at the Institute. An introductory course for Medical Officers joining the service, courses for senior officers of non-medical branches, refresher courses for Medical Officers, and, as many of you know, a course organised by this Panel of AGARD for NATO officers is to be held at the Royal Air Force Institute of Aviation Medicine in the spring of 1971.

It is sometimes forgotten that in the Royal Air Force some aviation medicine is taught to aircrew under the aegis of the Director General of Ground Training. This concerns survival particularly and is done within the individual Royal Air Force Commands at such places as the Jungle Survival School, the Winter Survival School, and the School of Combat Survival. Training is devised and undertaken by Medical and other officers from the Commands concerned.

Much remains to be done; for Medical Officers there is a need to improve the diploma course both in content and method of teaching; and systematic aeromedical training of Medical Officer (Pilots) would appear to be necessary. Standards of knowledge of aircrew must depend in the long run on the general aeromedical education of the Medical Branch, and it would seem essential to have some method for controlling and co-ordinating the teaching by Medical Officers undertaken in the wide variety of aircrew training establishments.

With regard to books, I believe that there is a need in the United Kingdom for a text book of aviation medicine following the syllabus of the diploma course, and I believe also that we all should keep firmly in front of us new teaching methods and techniques such as programmed teaching. In service organisations, which are prone to suffer from changes of staff, perhaps these new methods have more value than in education generally.

AEROMEDICAL TRAINING IN THE ROYAL AIR FORCE  
THE ROLE OF TRAINING SECTION AT THE ROYAL AIR FORCE  
INSTITUTE OF AVIATION MEDICINE

by

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#### SUMMARY

1. The responsibility for the education of medical officers of the Royal Air Force in Aviation Medicine is divided between the Medical Training Establishment (Administration), the Central Medical Establishment (clinical subjects), the Institute of Pathology and Tropical Medicine (preventative aspects and aviation pathology), the Aeromedical Training Centre (personal equipment) and the Institute of Aviation Medicine (physiological and psychological aspects).
2. The Institute's participation in this programme is organised by the training section and consists of a 5-day Introductory Course given to all Medical Officers on entry; a 3-week Orientation Course at approximately 5 year intervals; and a course of six months duration for the Diploma in Aviation Medicine offered by the Royal College of Physicians (London) and the Royal College of Surgeons (England).
3. The Section also organises 5-day courses for Senior Officers of non-medical branches on current aeromedical projects and research programmes, and short half-day presentations for Flight Safety Officers, Staff College Students and civilian Medical Aeronautical and Technical Societies; and will also provide external lecturers.
4. Syllabuses are derived from relevant experience, consolidated into programmes by discussion between lecturers, and validated by a continuing process of debriefing and consumer research by questionnaire. The content of any one course depends on the aim, however constant emphasis is placed on practical work and situational methods.
5. Lecturers are drawn from the training section, the research staff of the Institute, Hospital Consultants or civilian practitioners in Commercial Aviation or Government Agencies depending on the nature and status of the course. Lecture briefs are provided to avoid duplication conflict or discrepancies and ensure the correct orientation and continuity.
6. Classrooms are well equipped to modern standards; the research facilities of the Institute are utilised for practical work.
7. Experience has shown that there is a requirement for a comprehensive series of textbooks based on the syllabus, for specific teaching programmes in subjects with a degree of student resistance - such as statistics and psychology, and for instructional films designed for a post-graduate medical audience.

The responsibility for the education of medical officers in the Royal Air Force is divided between:

Medical Training Establishment .. .. .	Administration
Central Medical Establishment .. .. .	Clinical Medicine
Institute of Pathology and Tropical Medicine .. .. .	Exotic diseases and preventive medicine
Aeromedical Training Centre. .. .. .	Aircrew personal equipment
Institute of Aviation Medicine.. .. .	Aviation physiology and psychology

Training Section at the Institute is responsible for aviation physiology and psychology training but has further responsibilities in that it is tasked with the organisation of specialised courses for non-medical personnel. The courses run by Training Section can be summarised as follows:

#### Medical

Diploma in Aviation Medicine .. .. .	6 months
Introductory Courses for Medical Officers.. .. .	5 days
Orientation Courses for Senior Medical Officers .. .. .	3 weeks

#### Non-Medical

Senior Officers Courses .. .. .	5 days
Flight Safety Officers Courses. .. .. .	1 day

In addition, Training Section has to arrange visits to the Institute by outside organisations such as British and Foreign Staff Colleges, civilian medical and technical societies etc.

It is the intention of this paper to outline the teaching tasks of the medical and non-medical courses.

#### Introductory Courses for Medical Officers

At present newly commissioned medical officers come to the Institute for a five-day period of basic instruction in Aviation Medicine following one month's general service training at the Officer Cadet Training Unit, RAF Henlow. This phase is integrated into the general scheme of initial training.

#### Initial Training of Medical Officers

General Service Training .. .. .	1 month
Institute of Aviation Medicine. .. .. .	5 days
Aeromedical Training Centre .. .. .	5 days
Institute of Pathology & Tropical Medicine. .. .. .	5 days
Medical Training Establishment. .. .. .	5 days

It is considered that too much time devoted to detailed physiology at an early stage is detrimental and five days has been allotted to this aspect of the Introductory Phase. The object is not to attempt to train, that is to qualify a student to carry out specialised duties, but to make him aware of the scope of his new environment. Up to six or seven years ago the course attempted to give the new medical officer a comprehensive training in both theoretical material and practical skills but this was never successful. The student was subjected to 50 hours of instruction compressed into 2 weeks and all this did was confuse him with an abundance of factual information. At the same time he was expected to learn the skills necessary to enable him to fit equipment such as masks, helmets and pressure clothing. The reason for demanding such a high standard in those days was because the new medical officer might find himself in sole medical charge of a flying unit.

As the number of flying stations in the Royal Air Force has decreased over recent years so the chances of an inexperienced medical officer being posted single handed to such a unit have correspondingly diminished. He is posted nowadays to a unit to serve under a senior medical officer who can give him advice and the benefit of his greater experience and advanced training eg. Diploma in Aviation Medicine.

It was therefore on this basis that the present Introductory Course was designed. The initial aim was to make the subject as interesting as possible and thus to stimulate the student into acquiring further knowledge. There were two main reasons for this:

1. Aviation medicine is not taught in most medical schools so the junior medical officer is being presented with large areas of his future work that he did not even know existed. That most of his new areas of responsibility depend on a sound understanding of physiological principles comes as a surprise to him, as he thought that he had finished with physiology early in his medical student career.

2. It was found that most junior medical officers on entry had only a poor knowledge of both the working of modern air forces and of aviation generally. Hence there was a need to place specific physiological topics in context. This not only made them more meaningful but was in keeping with the educational principle that any teacher should instantly be able to answer his students' cry. "But why do we need to know about this?" Examples of this includes subjects such as ejection, survival and thermal stress. It was difficult to impress on a student the necessity for him to study the physiology of heat regulation in relation to, for example, cockpit heat stress in the tropics, when he did not know what the aircraft were which posed this stress, what their role was and what they were doing in the tropics anyway. References were made by students to dog fights and night fighters which indicated their out of date knowledge.

The teaching of the junior medical officer is carried out exclusively by Training Section staff who can from personal experience illustrate the various topics under discussion. It is considered that personal experience is an essential quality of staff members who have to teach junior medical officers. To teach theoretically from a book without the benefit of personal experience invariably fails with this particular group. It must be remembered that they are on the threshold of their careers and must be impressed at this stage.

The formal lecture technique is for the most part not adopted, classes becoming lessons in which the students, with direction from the staff, identify problems, and proffer possible solutions. No attempt is made to go into great technical detail as this only tends to confuse at this stage. In the case of assisted escape, for example, an idealised simplified system is taught so that the students can develop an understanding of the problems and general principles without worrying too much about the difficult task of remembering the detailed timings and workings of various system operations in the different marks of ejection seat. Great stress is however placed on the fact that the student has the responsibility of finding out, when he is posted to his unit, what type and mark of seat his aircrew will be using and the specific performance and technical details of those seats. By the application of this basic understanding of the principles involved it is felt that he emerges a more competent practitioner than the doctor whose basic training comprised learning performance data and operating techniques. In our opinion such a doctor is merely a medically qualified safety equipment worker.

At this point you are reminded that our five-day course is merely part of the junior officer's service medical training. When the student leaves the Institute he goes for a further week's instruction at the Aeromedical Training Centre at RAF North Luffenham. The five days spent at AMTC are concerned with the 'Familiarisation with Aircrew Equipment'. Here the junior medical officer sees and handles the hardware which is in current use and which has been designed to combat the difficulties that he has heard about during his week at the Institute.

The numbers per course are limited to ten or twelve. Such small numbers are advantageous as they tend to encourage a greater degree of relaxation in the staff/student relationship which is essential to this form of teaching. It was noticed that there was initially some resentment as the new doctors, comparatively recently escaped from the classrooms of their medical schools, found themselves back again behind desks with yet more facts to assimilate. This resentment was quickly dispelled if the formal classroom atmosphere was removed.

To summarise, the Introductory Course for Medical Officers attempts to arouse an interest in a branch of medicine which doctors have elected to follow but which is for the most part completely unknown to them. This is achieved by informal teaching, involving the students as much as possible. At the same time they are introduced to the Institute and see some of the research which is going on in the field of Aviation Medicine. By arousing their interest they are stimulated to continue their own learning and are helped in this by being directed towards sources of further information such as books, papers, publications etc., many of which are supplied during their course. Finally, with this groundwork, they are posted to units where they will work under the direction of a Senior Medical Officer who will continue their education until they are ready to progress further in their chosen careers.

#### Subsequent Training of Medical Officers

If the career of a typical non specialist medical officer is followed it is found that after a period of about five years he has served his apprenticeship out in the field under supervision. For the most part he has had no direct responsibility for aeromedical problems but naturally his expertise has grown with his increasing experience. At this stage if he chooses to concentrate

on the care and health of aircrew he can elect to take Study Leave to study for his Diploma in Aviation Medicine, which will give him both professional recognition and the service qualification of Flight Medical Officer. The details of the Diploma in Aviation Medicine are contained in a separate lecture. It must be pointed out for the sake of completeness that the Diploma does not automatically confer on a medical officer the status of Flight Medical Officer as it is concerned with aviation medicine in general so a further period of one month's study is required at the Institute and at AUTC during which the military aspects of aviation medicine are thoroughly covered.

What of the established medical officers continuation training? In the past Refresher Courses for Senior Medical Officers have been held at regular intervals. These courses have been supplanted by a new policy which directs that Senior Medical Officers should every five years attend an Orientation Course of three weeks duration held at the Institute. The title has been changed from 'Refresher' to 'Orientation'. This was to recognise the fact that most Refresher Courses spent their time revising old knowledge and never progressed from that stage so that all that was ever achieved was a steady state. The new course accepted the fact that the Senior Medical Officers have a considerable understanding of the subject of aviation medicine but require periodic updating of information and also an insight into future developments.

As with the other courses, adequate time is devoted to discussion because this particular group of students are practising doctors in the field of aviation medicine and can from their considerable practical experience bring to the notice of the lecturers any difficulties they themselves may have encountered in the field. In this way the course is considered of great value, providing the opportunity for a two way interchange of information.

It is not possible to present pictorially the complete programme for the course but a few examples of typical discussion subjects will illustrate how the course attempts to 'orientate'.

1. Recent developments and experience in assisted escape.
2. Some aspects of current aerodynamic design.
3. Recent and future developments in Oxygen Systems.
4. Effects of noise on communications in aircraft.

The course is also characterised by the fact that it is not confined to aviation physiology. Clinical aviation medicine is included and we have lectures and presentations by visiting senior clinical consultants and specialists.

This course in particular is concerned with the presentation of up to date information to the students, so naturally the services of leading authorities in the particular field are obtained. It is here that a recurrent source of trouble is encountered and one which must be familiar to all involved in teaching. The problem of the expert who is not a teacher. It matters not how expert the speaker is in his particular field; if he cannot transmit his information to the student he has failed in his task and we have failed in our intention. It is simply a matter of communication.

What is meant by that? The Institute has excellent lecture rooms fitted out with all the latest training aids, facilities for slide projection, film projection, Vu graph etc but all too often these facilities are not used at all or if they are, they are abused. All too often the traditional lecture is adopted, a monologue of up to 60 mins duration with a brief period at the end for questions. 35mm slides, if shown, are incomprehensible, and contain information which could perhaps be digested in a paper or publication but which in classroom visual display takes several minutes to decipher. While the student is attempting to do this his attention is diverted from the spoken word and there is a break in the train of thought and subsequent loss of information. Speakers time and again fail to realise that there is a requirement for specific teaching slides and that the straightforward reproduction of research data quite often fails in its purpose with a class. Lecturers are reluctant to change their habits and are indeed resentful of criticism which is intended simply to improve their presentation. From this point of view we are indeed fortunate in having the full time services of an Education Officer. Doctors appear to resent their professional colleagues' criticism but are prepared to listen to and take notice of an authority on teaching. Since the arrival of the Education Officer there has been a marked improvement in the standard of lecturing technique. Everyone tends to have a inflated opinion of his own ability when it comes to lecturing and it is surprising the sobering effect of a critique given by an Education Officer who has been sitting at the back taking notes of one's technique.

As a further example there is the problem of the blackboard artist. It is practically impossible to draw accurately on the blackboard at the first attempt the Oxygen Dissociation Curve. Everyone has seen lecturers attempts to reproduce its complex curves and then try to relate points on the curve to the axes. The answer lies in the Overhead projector. But of course it takes time to convert people to using new equipment and many people still believe that the only requirement to teach is the knowledge of the subject and a piece of chalk. However, it is not the aim of this paper to discuss modern methods of teaching or classroom communication but experience at the Institute has shown the value to any medical teaching organisation of the employment of a professional teacher to advise on such matters.

To pursue a little further this digression into the practical problems of teaching; everyone is aware of the difficulties posed by the shortage of adequate textbooks in aviation medicine. Many Air Forces produce their own Handbooks and Manuals but these tend to have a national bias and only highlight the need for a general textbook of balanced opinion and teaching in general principles. At the RAF Institute of Aviation Medicine this is overcome by providing the students with précis of lectures and with reprints of relevant papers covering the particular subject under discussion. At the present time an experiment is in progress using programmed texts to help the student in his unenviable task. The criticism of the lack of suitable textbooks also applies to that extremely valuable visual aid - the film. The environment of flight is extremely difficult to bring into the classroom. The film can help do this but there are very few good films made for the post graduate student of aviation medicine.

#### Non-Medical Courses

For several years now it has been considered by the Air Staff that all aircrew, especially those in supervisory and command appointments, and senior engineering and equipment staff, with day to day responsibilities for the servicing and supply of present day equipment, need to have a thorough knowledge of the physiological problems of aviation. To this end the Institute provide six 5-day courses per year for senior officers of the rank of Squadron Leader and above in the previously defined appointments.

The course syllabus is designed to provide:

- a) Background knowledge of aviation medicine.
- b) A review of problems currently facing aircrew with emphasis on those problems of more recent importance.
- c) Review of current trends in aircrew equipment and of the latest equipment in operational use.
- d) A survey of matters of operational importance in the current research programme of the Institute.
- e) Ample opportunity for discussion of individual problems in Aviation Medicine with the Institute Staff.

This course is again thought to be valuable because it affords excellent opportunities for the exchange of ideas and opinion. It brings to the Institute, senior officers of wide ranging experience, from different commands but usually with a degree of built-in scepticism about the importance of aviation medicine and downright criticism of the efficiency of in-service items of equipment. Recruiting for these courses is allegedly on a voluntary basis, but does not appear so in practice. Commands are allocated vacancies but inevitably we find the courses under-subscribed on the voluntary basis - the numbers are invariably made up of officers detailed to attend.

There are usually on the first day several suspicious faces and so time is devoted to explaining why they are here and what is going to happen. It is explained that the object is to encourage open discussion, that they are at liberty to question opinion and dogma and their questions and problems will be appreciated and valued. When the initial reticence of the student posted onto a course and his antipathy to the lecturer facing him is broken down, the atmosphere becomes more relaxed, tongues are loosened and the course proceeds.

No more than four presentations are arranged for each day, giving at least half an hour's discussion time at the end of each session. In practice it is found that rather than having to deal with a few forced questions compressed into the final five minutes most speakers have great difficulty in escaping before the next speaker arrives at the classroom.

A comprehensive de-brief is always conducted at the end of each course and as yet there have been no dissatisfied customers. The students invariably suggest that more general duties officers should attend the courses. It is felt that here our publicity organisation is at fault. For many years doctors in aviation have been viewed with suspicion because they only speak to aircrew either through lectures or articles in Flight Safety magazines. Usually the content of these lectures has been prophecies of doom or warnings of what might happen if....! This has accounted for the poor appeal of courses in aviation medicine and the reluctance to volunteer for them. Experience with the Senior Officers has shown that once they have been placed in a direct face to face situation and that once the problems have been explained to them, the difficulties are appreciated much better. Courses depart as effective ambassadors because they possess understanding as well as knowledge.

The detailed programme varies from course to course, each one being tailored to the interest of the course members. If there is a predominantly aircrew course then the presentation concentrate on their immediate interests and so on.

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It has already been stated that the formal classroom tends to inhibit students - indeed the very title of student is intimidating and signifies some degree of inferiority. Appreciating this, the words students and lecturers will be eliminated from the vocabulary in future. Lecture rooms will be re-arranged so as to destroy the classroom image with its rows of desks and schoolroom atmosphere. Small points, but it must not be forgotten that the prime aim of teaching organisations is the efficient acquisition of knowledge through understanding by the "student" and here the word student is used for the last time.

#### Directorate of Flight Safety Courses

Each flying station in the Royal Air Force has its Flight Safety Officer. During the initial training of Flight Safety Officers each course spends half a day at the Institute where they are given on average three presentations on aeromedical aspects of flight safety. The subjects vary depending largely on the availability of lecturers but are usually concerned with general flight safety topics such as a psychologist discussing "Human Error" or a biodynamicist talking about Recent Ejection Experiences. A small task but an essential one in the wider dissemination of knowledge of matters of aeromedical importance throughout the non-medical branches of the Royal Air Force.

CURRENT AEROMEDICAL EDUCATION IN FRANCE

by

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## ABSTRACT

### 1. BASIC TRAINING IN AVIATION MEDICINE

1.1. Air Force doctors intending to practise in flying units attend a four-month training course at the Aviation Medicine Specialty School.

This School is attended by young physicians having recently been awarded their diploma, who will practise in the military sphere during periods ranging from a few years to a whole career. The aim of the assignment is to provide theoretical education, clinical and practical training, and to promote the integration of the future flight surgeon into his new and very specific medium.

The problems arising are related to a necessary evolution of relationships between teachers and students.

1.2. The School organizes courses of various duration for the training of reserve Air Force doctors.

1.3. Aeromedical training in civilian universities is provided through lectures and visits which vary slightly in number and importance according to the medical colleges. Doctors who then obtain their Aviation Medicine diploma can conduct medical examinations in aviation clubs.

### 2. HIGHLY SPECIALISED TRAINING IN AVIATION MEDICINE

Aeromedical specialists of higher level are recruited and trained by the Air Force, according to accurate and prescribed standards. Physiologists go through the successive stages of "assistanat" (4 year laboratory and college studies), then take a competitive examination for the title of "research specialist of the Armed Forces Health Service".

Clinicians take corresponding competitive examinations to get their medical "assistanat", and then become physicians or specialists in military hospitals.

Finally, after taking an "agregation" competitive examination, the latter can become professors in one of the specialties taught at the aviation medicine specialty School. Modifications of this scheme are being planned.

Civilian education systems do not provide competitive examinations ratifying very specialized training.

### 3. TRAINING OF PARAMEDICAL PERSONNEL

In France, training is provided for civilian and military air transport hostesses. Personnel in charge of pressure chambers is given specialised training.

## RESUME

### 1. LA FORMATION DE BASE EN MEDECINE AERONAUTIQUE

1.1. La formation des médecins de l'Armée de l'Air destinés à exercer dans les unités volantes se fait par un stage de quatre mois à l'Ecole de spécialisation de médecine aéronautique.

Cette école reçoit de jeunes médecins récemment diplômés qui exerceront en milieu militaire pendant une période allant de quelques années à toute une carrière. Le stage vise à la fois à donner un enseignement théorique, une formation clinique et pratique, et à favoriser l'intégration du futur médecin de l'Air à son milieu nouveau et bien particulier.

Les problèmes qui se posent sont liés aux nécessités de l'évolution des relations "enseignants-enseignés".

1.2. L'école organise des stages de plus ou moins longue durée pour la formation de médecins de réserve de l'Armée de l'Air.

1.3. La formation en médecine aéronautique en milieu universitaire civil se fait par un ensemble de conférences et de visites dont le nombre et l'importance varient légèrement selon les facultés de médecine. Le diplôme de médecine aéronautique qui peut être ensuite obtenu permet aux médecins qui le possèdent d'assurer les examens médicaux dans les clubs d'aviation.

### 2. LA FORMATION HAUTEMENT SPECIALISEE EN MEDECINE AERONAUTIQUE

Les spécialistes de médecine aéronautique des niveaux supérieurs sont recrutés et formés en milieu selon des normes réglementaires précises. Les physiologistes passent les étapes successives de "l'assistanat" (4 ans d'études en laboratoire et en faculté), puis du concours de "spécialiste de recherches du service de santé des Armées".

Les cliniciens passent des concours équivalents d'assistanat de médecine, ou de spécialiste des hôpitaux des Armées.

Ces derniers peuvent ultérieurement, après un concours d'agrégation, devenir des enseignants d'une des spécialités enseignées à l'Ecole de spécialisation de médecine aéronautique. Des modifications de ce système sont actuellement en projet.

Il n'y a pas en milieu civil de concours réglementant la formation très spécialisée.

### 3. FORMATION DU PERSONNEL PARA-MEDICAL

Il existe en France une formation des hôtesses pour l'aviation de transport civile et militaire. Le personnel chargé des caissons à dépression reçoit une formation spécialisée.

In France, aviation medicine is taught both from theoretical and practical viewpoints to various categories of personnel: physicians, aircrews, engineers, business personnel, paramedical personnel. This paper deals solely with the training given to physicians, and is based on long and concrete teaching experience.

## I BASIC TRAINING OF PHYSICIANS SPECIALIZED IN AVIATION MEDICINE

### A) MILITARY

The main aviation medicine training provided in France is that of the Air Force medical officers.

All the doctors who have obtained their degree and are called upon to serve in the Air Force during periods ranging from a few years to a whole career attend a four-month course at the Ecole de Spécialisation du Service de Santé pour l'Armée de l'Air (Health Service Specialisation for the Air Force).

This course follows a six-month assignment at the Application School of the Armed Forces Health Service, during which the strictly military aspects of a medical officer's training are covered\*.

This allows the four-month course to be devoted to specifically aeronautical training, as all the knowledge necessary to practising military medicine has been previously acquired.

According to the regulations in force, the main purpose of the Specialisation School is to provide doctors with "the complementary professional teaching necessary for the accomplishment of their mission".

This primary objective can be achieved through two intermediate objectives:

- 1) The School gives its students the knowledge necessary to practise aviation medicine on the flying personnel of the units.

This knowledge is of a theoretical, practical and clinical nature; it covers aviation physiology, medicine, psychology and psychiatry, otorhinolaryngology and ophthalmology, biochemistry and biophysics. It also covers the organization of the Air Force and the connections between the Health Service and the Air Force at various levels.

Such knowledge is provided by means of lectures, practical demonstrations in various Health Service laboratories (Central Aeronautical Biology Laboratory and Aerospace Medical Laboratory of the Bretigny Flight Test Centre), clinical assignments (in hospitals, in services dealing with aviators, in medicine, ophthalmology, otorhinolaryngology, or in psychiatric services outside hospitals: e.g. the Air Force Medical Centre of Clinical Psychology).

Therefore, in teaching the curriculum, one takes account on the one hand of the necessity of providing students with surveys and synthetic reviews on the topics with which they have to become familiar, but, on the other hand, one does not lose sight of prevailing positions and interests of most students.

It is essential to consider these positions and interests for tuition to be effective, and for communication to be created between the teaching staff and students, thus allowing a better integration of knowledge.

The students attending these courses are recently graduated doctors, having just obtained their officer's commission; most of them have held responsible functions in hospitals during the last years of their medical studies.

Most of these young doctors are primarily interested in the clinical aspect of medicine, particularly the physiology and psychopathology of the Flying Personnel to whom they will have to attend.

It is therefore essential not to consider them as beginners or uninstructed students, but rather as acknowledged doctors desirous of acquiring a specialty, and with whom dialogue is possible and desired.

It is also essential to emphasize all the clinical aspects of aviation medicine since this facet is the best understood.

Teaching methods have been used to reach these objectives and to maintain the interest of the students participating in the course. For instance, round table discussions are frequently held; they gather specialists of various disciplines to discuss the same theme. As far as some subjects, such as psychology, are concerned, dynamic group psychology techniques have been resorted to: their purpose was to help students to discover some clinical facts, which professorial lectures could not have achieved. In some aspects, this teaching

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\* In the French Armed Forces, the Health Service is common to the three services: Army, Navy, Air Force.

of psychology was closely related to M. BALINI's work. It has enabled the students to get to the facts to learn through a personal approach, both individual and in groups, thus making knowledge integration possible after actual experience.

For the last few years the predominant feature in the general trend of teaching has been emphasis on clinical teaching as compared to physiology teaching, which used to prevail. Another important characteristic has also been the development of the most specific and applied aeronautical physiology, to the detriment of traditional experimental physiology. A certain development of pedagogic research should also be pointed out, although varying according to the disciplines considered.

- 2) The School also aims at the preparation of students to become integrated into the environment where they will be called upon to live and work for a number of years.

It is always difficult to pass on from being a student to being a professionally responsible person. This is a turning which the School should help students to take.

This aim can be achieved, of course, by providing the doctor with the scientific knowledge necessary for practising; however, this is not sufficient. The School should also facilitate a kind of previous integration into the environment, thus warding off adaptation difficulties which would not fail to aggravate the obstacles to be overcome by entrant doctors.

In order to do this, the School uses three different working techniques or methods:

- a) It promotes familiarity with the Air Force environment: visits to air units, meetings, discussions with aircrew and with doctors serving in the Air Force complement the organization data provided by the courses.
- b) Air trips of varying durations enable the students to live with the aircrew, to become familiar with their work, and to share their emotions. This assists the doctor in his attempt to identify himself with his potential patients - the aircrew.
- c) For a period of four months the students will share the life of their teaching staff.

Now this teaching staff is very much under the influence of the particular climate which pervades the Air Force. In the French Air Force, men, aircrew, are very close to each other, because of their professional motivations - flying and their love for flying - and because of the emotions shared both in wartime and peacetime. This closeness, this identification of individuals with one another marks their relationship more than hierarchical positions.

Doctors serving in the Air Force are of course characterized by this climate, which the teaching staff reflects all the more in their students in that classes are limited in number and may operate as small groups (15 to 25 students).

Therefore, during this four-month course, doctors can develop a preliminary identification with the profession they will practise and with the environment into which they will have to integrate themselves. This process is an indispensable complement to that of acquiring medical knowledge.

It is part of the mission of the School to ensure a post-graduate aeromedical training.

This teaching has not yet been finally organized. However, it justifies some preliminary remarks. Generally speaking, in civilian spheres, post-graduate training raises problems which are difficult to solve at present and require research; this research is now starting in France. In addition particular problems arise in a military environment: the relative isolation on a unit doctor should result in the organization of refresher courses aiming not only at providing new knowledge, but also at promoting the exchange of information and experience between practitioners, hospital doctors and researchers. Such a proposal is supported by considerations on the medical officer's corporate feeling, motivation, etc.

## B) CIVIL

In the civilian field, aeromedical training varied according to the university. Some - not all of them - provide the training required for an aviation medicine diploma; this training is most frequently organized by physiology researchers and professors. At the Faculty of Medicine of Paris, such teaching includes 50 lectures, with visits, practical work and demonstrations. Examinations take place at the end of the course, with the award of a diploma enabling its holder to conduct medical examinations in flying clubs.

## II HIGHLY SPECIALIZED TRAINING IN AVIATION MEDICINE

A) In civilian circles it is the specialised work and research conducted by some experts that win their author's competence and repute in certain fields of aviation medicine. Many of these

researchers also fulfil teaching duties in a university, mainly in physiology. There does not, however, exist any competitive examination for the recruitment of such specialists, at any level.

B) In military circles the needs for specialized personnel are much higher. The Air Force needs personnel to conduct "applied research", with a view to developing the equipment necessary to aircrews' adaptation to modern flight. As for the Health Service, it requires a teaching staff specialized in the various disciplines related to aviation medicine (see paragraph I).

The training of these various categories of personnel goes through the preliminary stage of recruitment. The "assistantat" competitive examinations enable those who succeed to study four years in a laboratory, or in a military clinical centre, while simultaneously conducting studies leading to civilian titles. (As a matter of fact, for the time being, military competitive examinations do not grant to those who pass them an equivalence to corresponding civilian titles).

During his four years of training, the "assistant" is not a student: he is an already specialized physician who carries out team research work, or assumes clinical responsibilities, on a collaboration basis, according to the orientation he has chosen.

It is also in view of this orientation that he will choose either the competitive examination organized for "research specialists", or that leading to the status of clinical discipline specialist (Otorhinolaryngology, Ophthalmology, Psychiatry, Psychology, Medicine) which will warrant the work performed during the preceding years.

Beyond that stage, the researcher who has been active in a laboratory for a number of years and has accumulated work may go in for the "maître de recherches" competitive examination, the highest step in this hierarchy, and thus become adviser to other researchers and to the Command.

On the same level, and each in their own specialty, are those who orient themselves towards teaching. They take an "agregation" competitive examination, after which they hold a position at the Health Service School of Specialization for the Air Force.

These various types of training have gradually evolved in two opposite and successive directions. To the initial phase of development of aviation medicine in France corresponded a parallel development of highly specialized training and of the competitive examinations which led to it. After the "biologist" created in 1949, appeared successively the "assistantat", then the research specialist competitive examination, then the specialized "agregations", and finally the "Maître de recherche" titles.

During these last few years, the setting up of a single Health Service was a predominant requirement which brought about a homogenization of the competitive examinations in the three Services, which were initially different from each other.

We are now living through a transition period: some new competitive examinations have been created, some others are pending. Adjustments should obviously be devised to allow each of them to retain the essence of its specificity while general harmonization is maintained.

One problem remains to be solved: the creation in France of an equivalent to the American "Flight Surgeon". Such a specialist should combine a specific medical training, both physiological and psychophysiological, and a pilot's training. His value would thus be acknowledged both by engineers and aircrews, and better results would be achieved both in research and in the medical control of flying personnel.

This twofold position is at present being held in France by some of the Flight Test Centre doctors; the very existence of these pilot doctors proves their necessity. This should be officially recognized and the assignment of such doctors should be extended beyond Flight Test Centres.

## CONCLUSIONS

One might conclude this survey by enumerating the reasons for being satisfied with the present teaching of aviation medicine in France. It is however more profitable, as well as a possible source of discussion, to stress the problems yet unsolved and the difficulties encountered.

Each nation and, within each nation, each Service has its own traditions, and the training it provides, while it is organized in view of the aim to be reached, is also marked by national traditions and peculiarities.

The problems raised by aeromedical teaching in the French Air Force were for a long time related to the insufficiently clinical nature of such teaching. But these are bygone days. The present problem - yet unsolved - is that of the purely aeronautical specialization of the Air Force doctor: should it be emphasized for all doctors, and, if not, for which? Replies to this question differ in all countries. We shall be extremely interested in an exchange of views on this subject.

AEROMEDICAL TRAINING PROGRAM  
FOR MEDICAL AND PARAMEDICAL PERSONNEL  
IN THE GERMAN ARMED FORCES

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### Summary

Types, duration and curricula of training courses held at the Institute of Aviation Medicine of the German Air Force in Fürstenfeldbruck are described.

#### 1. Primary Course in Aviation Medicine

A 10-week course provides knowledge in physiology of flight and in all fields of clinical aviation medicine, examination methods and pertinent medical fitness regulations. Special emphasis is placed on questions pertaining to aviation pathology, prevention and investigation of aircraft accidents and flying safety. Practical indoctrination and field-trips to flying units familiarize prospective Flight Surgeons with their duties and responsibilities.

#### 2. Indoctrination of Medical Officers in Aviation and Industrial Medicine

A 3-week course for medical officers stationed on air bases, but not as Flight Surgeons, presents basic knowledge in the fields of aviation - and industrial medicine.

#### 3. Aeromedical Training Sessions for Dentists in Charge of Treating Flying Personnel

Familiarization courses of one week's duration orient dentists on line assignment about essential aeromedical subjects of interest, especially about experiences gained in and directives applying to dental treatment of flying personnel.

#### 4. Course for Aeromedical Technicians (Flight Surgeon's Assistants)

In a 6-week course Aeromedical Technicians (Flight Surgeon's Assistants) are instructed in fundamentals of physiology of flight, appropriate assistance in physical examinations, medical care and treatment of flying personnel, and prevention and investigation of aircraft accidents. A knowledge of all administrative processes completes the training for the most important assistant of a Flight Surgeon.

#### 5. Course for Air Evacuation Personnel

A 3-week course for non-commissioned officers of the medical service is designed to familiarize them with the problems of aeromedical evacuation in accordance with international agreements (STANAG 3204).

### Sommaire

Nature, durée et programmes des cours de formation organisés à l'Institut de Médecine Aéronautique de la G.A.F. (Armée de l'Air Allemande) à Fürstenfeldbruck.

Au cours de dix semaines de Stage Primaire pour Médecins de l'Air, les étudiants reçoivent une formation de la physiologie du vol et dans tous les sujets cliniques de la médecine aéronautique, de ses méthodes de diagnostic et les règles se rapportant à l'aptitude. En outre une attention particulière est consacrée aux questions liées à la pathologie aéronautique, à la prévention des accidents aériens et aux enquêtes sur ces accidents ainsi qu'à la sécurité des vols. Des démonstrations et des visites d'unités opérationnelles familiarisent les futurs Médecins de l'Air avec les tâches et les responsabilités qui les attendent.

Au cours d'un stage de trois semaines les officiers médecins, stationnés sur les bases, mais non en qualité de Médecins de l'Air, sont familiarisés avec les connaissances fondamentales dans les domaines de la médecine aéronautique et la médecine du travail.

Des cours d'une semaine permettent aux dentistes de se familiariser avec les principaux problèmes aéromédicaux qui peuvent les concerner. L'objectif poursuivi est d'uniformiser les procédés relatifs aux soins dentaires en se fondant sur l'expérience acquise auprès du personnel navigant. Au cours d'un stage de six semaines les Techniciens de Médecine Aéronautique (Assistants des Médecins de l'Air) reçoivent une formation dont le programme comprend les principes de base de la physiologie du vol, la partie pratique dévolue aux infirmiers dans les examens médicaux, les soins et les traitements du personnel navigant ainsi que la prévention des accidents aériens et les enquêtes qui leur font suite. La connaissance de toutes les fonctions administratives complète la formation pour l'assistant le plus important du Médecin de l'Air.

Conformément aux accords internationaux (STANAG 3204) les sous-officiers du Service de Santé sont formés au cours d'un stage de 6 semaines aux principes des Evacuations Sanitaires Aériennes.

The Schooling Section for training of medical officers and medical personnel in the field of aviation medicine is one of the latest establishments at the Institute of Aviation Medicine of the German Air Force in Furstenfeldbruck. It was activated in 1966 and became an essential branch of the Training Division, which at the same time is responsible for the centralized execution of physiological training for all flying personnel of the German Armed Forces through its training groups.

The tasks of the Schooling Section, which I should like to cover here, are as follows:

1. Training of Flight Surgeons in the Primary Course in Aviation Medicine
2. Indoctrination of Medical Officers in Aviation and Industrial Medicine
3. Aeromedical Training Sessions for Dentists in Charge of Treating Flying Personnel
4. Course for Aeromedical Technicians (Flight Surgeon's Assistants)
5. Course for Air Evacuation Personnel.

#### Primary Course in Aviation Medicine

This course is scheduled to last 10 weeks and is intended for training of junior aeromedical officers. Its immediate purpose is to provide future Flight Surgeons with the basic theoretical knowledge and above all with the practical qualifications required for the proper execution of their responsibilities. Within the scope of these functions the Flight Surgeon is expected to have specific knowledge pertaining to examination techniques, diagnostics and treatment of flying personnel. On the other hand he should also be able to cope with problems of industrial medicine in flying operations. In addition he has to hold lessons intended to keep the knowledge of flying personnel with respect to physiological training up-to-date. In his capacity as special adviser to the commander on organization of leave and leisure time, scheduling of flying- and duty-hours, questions relating to sports- and functional medicine he is expected to accomplish his part. He must also participate in the prevention and investigation of aircraft accidents and incidents.

Consequently the training program not only provides the theoretical knowledge, but places special emphasis on practical indoctrination.

In detail the plan provides information on administrative procedures of the aeromedical service in addition to an introduction into general subjects of the historical development and tasks of aviation medicine. The subjects of physiology of flight covering knowledge pertaining to flight environment and specific effects of flight form the basic structure for all aeromedical comprehension. In 23 academic lessons the effects of altitude, biodynamic influences of flight, rescue and survival procedures and regulations are explained and supplemented by extensive demonstrations of 15 total hours, including a chamber flight.

This is followed by 21 hours of instructions dealing with prevention of illnesses, rehabilitation and methods of detailed diagnosis. This includes also an introduction into biotelemetry and particularly into medical data processing.

Subjects of clinical aviation medicine are covered extensively. The dominant point is not to discuss basic knowledge considered to be a prerequisite for physicians but to cover additional specific professional knowledge important to the Flight Surgeon. Pertinent physical fitness regulations are discussed in detail for each specialty. Furthermore particular problems of various specialties are treated thoroughly. Thus a total of 9 hours are available for internal medicine and 10 hours for subjects of the ENT specialty. The field of ophthalmology necessitates an even more intensive indoctrination since experience shows Flight Surgeons to have less background ophthalmological knowledge than required. As a result 20 hours of instruction are devoted to this specialty. Neurological and psychiatric subjects are deliberately confined to the presentation of such emotional and mental disturbances, which may play a part in flying assignment and constitute partial or complete incapacitation for military flying duty. In our opinion 5 hours assigned to this subject are sufficient considering the fact that fundamental knowledge taken for granted in trained physicians can be dispensed with. 3 hours each of theoretical instructions in radiology, dentistry, and laboratory techniques cover specific skills and circumstances characteristic of physical examinations of flying personnel.

In the field of clinical aviation medicine the knowledge gained is consolidated by practical clinical exercises of several hours' duration.

Psychology is also concerned with specific and practical problems of flying, especially those relating to types of operation and mission and the resultant psychological stress, but also with questions pertaining to psycho-physical performance functions and accident psychology. The 6 hours spent on these subjects are complemented by practical indoctrination into and demonstration of psychological testing equipment and by introduction into examination methods.

Detailed instructions on aeromedical aspects of aviation accidents and aviation pathology amounting to 23 hours follow. We consider this specialty to be of very great importance since the Flight Surgeon is repeatedly faced with the problem of investigating and clarifying an aircraft accident or incident. He then must give his expert opinion. We also keep in mind that every aircraft accident constitutes an experiment - unfortunately often fatal - from which new knowledge can be deduced. For these reasons the general and special tasks of aviation pathology as well as technical and physical processes in aircraft accidents and type and infliction of particular injuries are covered in great detail. In addition measures at the scene of the accident for preservation of traces and securing of evidence, of identification and fundamental rules for autopsies and their value for clarification and reconstruction of aircraft accidents are dealt with. Questions relating to aviation toxicology and problems involved in shipment of specimens as well as performance of chemical, histological and physio-chemical examinations are discussed. Administrative procedures in preparing written expert opinions on aircraft accidents, which, in the last analysis, constitute the summary of experiences gained, are adequately considered.

In logical sequence lectures on flying safety follow those on aviation pathology. The dominant areas of instructions are technical and flying measures for prevention and investigation of aircraft incidents and accidents. It is our opinion that the Flying Safety Officer is one of the most important counterparts of the Flight Surgeon in his everyday work on an air base. Therefore the foundation for this important cooperation should be laid in the Primary Course in Aviation Medicine.

Furthermore future Flight Surgeons are familiarized in 6 hours of instruction with the most important procedures and regulations governing aeromedical evacuation. It seems important to us to pass on to our Flight Surgeons experience we ourselves and other nations have gained in World War II and those acquired quite recently in the course of belligerent events.

Profound knowledge in the field of epidemiology, pertinent requirements of law and necessary vaccination measures are very important considering the threat of quick dissemination of communicable diseases in modern air travel. These specific hazards are consequently covered in four hours.

Since air bases constitute large-scale establishments, introduction into industrial medicine is of great importance. In particular it is necessary to supervise technical installations on air bases and execute measures of industrial hygiene, including toxicological aspects of flight operations.

The tasks of Flight Surgeons are characterized by multiplicity and differentiation. Prerequisites and circumstances differ from unit to unit. For this reason a total of 8 training days are set aside for field-trips to various flying units. Course participants are familiarized with particular problems and peculiarities of an F-104 unit, a naval air wing, and an army aviation battalion. They are also confronted with problems arising at pilot training schools and helicopter units. At the same time this opportunity is used to demonstrate survival and rescue at sea. A field trip to the Training School for Airborne Operations and Air Transport affords an insight into training for paratroopers. Important and diverse loading techniques of transport aircraft are demonstrated, with a special view towards aeromedical evacuation.

One afternoon every week is reserved for sports, and the course participants have one study-hour a day.

Participation of training course in the 2-day Aeromedical Symposium is scheduled. Such Flight Surgeon's Meetings are held twice a year at the Institute of Aviation Medicine of the German Air Force.

The knowledge gained by course participants is assessed in one intermediate test, multiple choice system, and in one thorough end-of-course-test in writing.

The course language is German. Foreign German-speaking students may attend.

#### Indoctrination of Medical Officers in Aviation and Industrial Medicine

The curriculum of this course is similar to that of the Flight Surgeon's Course, however limited to essentials in the various specialties. Again physiology of flight forms the basic structure with a total of 11 hours and supplementary skill demonstrations of 8 hours. Introductory subjects concerning responsibilities and organization of aeromedical service and implications of aerospace medicine and the most important administrative procedures in connection with aeromedical duties are covered in a total of 8 hours. Clinical aviation medicine is also presented with all its specialties, whereby problems in respective fields are covered as follows: Internal medicine 3 hours, ENT-branch 5 hours, ophthalmology 4 hours, neurology and psychiatry 2 hours. Examination methods of functional medicine and detailed diagnosis are covered in 6 hours. Problems of x-ray diagnostics, dentistry and laboratory diagnostics are offered in 5 instruction hours.

Aviation psychology illustrates problems of pilot selection and performance criteria as well as aspects of accident psychology in approximately 3 hours and gives an introduction into the examination techniques of the specialty by additional practical exercises on psychological testing equipment.

In this course emphasis is again placed on aeromedical aspects of aviation pathology to familiarize medical officers with all complexes arising from prevention and investigation of aircraft accidents.

Further demonstrations of pathologic findings and of life saving measures at the scene serve to illustrate action to be taken at the spot and proper ways of conduct.

A short introduction into questions of aeromedical evacuation is designed to acquaint medical officers with the tasks of sub-units for aeromedical evacuation assigned to their organizations. Specific duties and problems on the part of industrial medicine existing on air bases are presented in 4 hour instructions.

One study hour a day has again been provided for this course.

The level of knowledge achieved by course attendants is assessed by a final test.

#### Aeromedical Training Sessions for Dentists in Charge of Treating Flying Personnel

This training project is a 1-week familiarization course for dentists on line assignment stationed on air bases, who have to take care of personnel on flying status and are responsible for their treatment.

In this manner nearly all air force line dentists were able to participate in such courses. Selected subjects from the field of physiology of flight and clinical aviation medicine are presented to them, inasmuch as these topics are of interest to dentists and show points of contact

with their own specialty. At the same time and beyond this objective the topics serve to convey knowledge which should be universal property of all medical officers responsible for handling aviation problems. Furthermore meetings of this nature serve to clarify and formulate uniform treatment directives and procedures through professional discussions among dentists.

So far all dentists have attended a 3 1/2 day training course. Therefore the course has been rearranged and subjects of the program have been changed.

The inclusion of dentists in the training program was highly welcomed and serves the primary purpose of improving cooperation between Flight Surgeons and dentists and at the same time is most favorable for prospective measures and mutual understanding.

#### Course for Aeromedical Technicians (Flight Surgeon's Assistants)

This course lasts 6 weeks. Physiological and clinical topics are seen more under practical aspects commensurate with the educational level of the course participants.

All Aeromedical Technicians, the assistants to Flight Surgeons, their right hand so to speak, must be familiar with all supervisory administrative functions of the Flight Surgeon's Office. Therefore all duties and administrative matters are covered in the same detail. Again knowledge in physiological changes and biodynamic influences of flight form the fundamental structure of the lessons, whilst the clinical specialties are almost exclusively treated under practical aspects. Naturally these various faculties are concerned with the appropriate physical fitness regulations, the knowledge of which is a must for the aeromedical technician.

In internal medicine examination methods for medical service auxiliary personnel have priority and problems of prescription and tolerance of medicaments and drugs are discussed. The ENT-specialty stresses ENT disturbances caused by air pressure variations, the effects of noise, and respective protective measures including the so-called Ear Protection Program. Practical training therefore centers essentially around audiometric examinations with corresponding on-the-job training phases. Ophthalmology covers the most important anomalies of the visual organ and its physiological performance. Aeromedical technicians are familiarized with practical ophthalmological examination methods. Another keypoint of clinical aviation medicine are the examination methodology, x-ray diagnostics and laboratory diagnostics, since aeromedical technicians should be able to conduct and supervise examinations of this nature independently. On the other hand there are no lessons on aviation psychology in this course, since this would be outside the scope of responsibilities of aeromedical technicians. Of great importance, however, are prevention and investigation of aircraft accidents, which results in thorough indoctrination through Flying Safety Officers and in voluminous subjects in the field of aviation pathology. This special training is also geared to the more practical aspects, namely measures at the scene of accident, assistance in removal of injured personnel and fatalities, assistance in and preparation of autopsies, securing and shipment of specimens and the like. Supervisory tasks of medical personnel while engaged at scenes of accident are appropriately accentuated. Suitable installations and equipment of recovery and crash vehicles, provision of adequate investigative material, aid in cases of serious injuries, burns and shock are again mentioned.

In 5 instruction hours aeromedical technicians are familiarized with the problems of aeromedical evacuation and with international regulations and agreements. Questions relating to industrial medicine of importance on air bases are discussed with a view towards supervision of technical installations.

The importance of immunization and protection against epidemics in international air traffic is pointed out since medical service auxiliary personnel aid substantially in the maintenance of an adequate immunization status especially in flying personnel.

In this course also field-trips to troop units illustrate in detail the diversity of the situation at various flying units and aids materially in achieving the training objective. These trips are carried out to the naval air force, pilot training schools, army aviation units and to the Training School for Airborne Operations and Air Transport, similar to those already mentioned under the Flight Surgeon's Course.

#### Course for Air Evacuation Personnel

This is the latest type of training course conducted at the Institute of Aviation Medicine of the German Air Force. It has only been started this year.

During activation of specific sub-units for aeromedical evacuation in the separate medical units (medical squadrons) the necessity of training personnel assigned thereto emerged. The course is provided roughly in line with international recommendations listed in STANAG 3204 and attempts to teach specific knowledge for aerial transport in a 3-week course. In particular the interaction of Forward, Tactical, and Strategic Aeromedical Evacuation and necessary organizational steps are presented. Internationally accepted nomenclature and standard terminology as well as modes of classification and assessment of priorities are taught.

The most important aerophysiological and biodynamic influences of flight are also covered to create understanding for special measures on patients in aerial flight.

Transport capacity, deck-utilization and types of aircraft used in aeromedical evacuations are thoroughly dealt with and supplemented by appropriate practical exercise on mockups and aircraft. Some essential clinical aspects which warrant special attention in aerial transport are also explained.

At the Institute of Aviation Medicine we conduct a total of 9 - 10 training courses each year, resulting in 31 - 34 training weeks and approximately 200 - 250 course graduates.

A breakdown is as follows:

Number	Course Title	Training Weeks
1	Primary Course in Aviation Medicine	10
1 - 2	Indoctrination of Medical Officers	3 - 6
3	Training Sessions for Dentists	3
1	Course for Aeromedical Technicians	6
3	Course for Aeromedical Evacuation Personnel	9
9 - 10	total	31 - 34

To complete the survey of training courses at our institute, I should like to mention 2 more courses, which I did not cover in detail, because they are optional, namely

a 2 week Basic ECG Course and a 1-week Advanced ECG Course,

normally held once a year.

EDUCATION AND TRAINING IN AEROSPACE MEDICINE  
IN THE ROYAL NORWEGIAN AIR FORCE

by

Dr. Fr. Vogt Larentzen,  
Royal Norwegian Air Force,  
Oslo, Norway.

#### ABSTRACT

1. Flight surgeons on compulsory service in the Norwegian Air Force take a three week course in Aviation Medicine. We feel that the course is too short to make the surgeons so familiar with aviation medicine that they are competent to give lectures to flight personnel on the air bases. These lectures are therefore usually given by flight surgeons on permanent duty.

The majority of the flight surgeons on permanent duty are trained in aviation medicine in the USA and UK. The Army and Navy surgeons are not trained in aviation medicine.

2. The physiological training of military aircrew is carried out according to STANAG 3114. It has often been pointed out by the Head of the RNoAF Aeromedical Institute that it may be tiresome for experienced pilots to attend the same lectures every third year. He states that he would prefer to give more detailed lectures about selected subjects. It is of interest to hear the opinion of other countries.

3. The RNoAF also gives education and training of flight nurses. They are recruited from civilian hospitals and other civilian places, in peace time on a voluntary basis. They go through a two week flight nurse course. Afterwards, one has to give them "flight experience" in military aircraft.

In wartime they will serve as military flight nurses. Flight nurse courses are performed according to the need of personnel.

I would like first to outline the organization of the medical service for the Royal Norwegian Air Force. The continuity of practical medical and aeromedical work is based mainly upon doctors who are permanently attached, but only on a part-time basis. Only the Head Surgeon of the Royal Norwegian Air Force is employed full-time. In addition to these permanent doctors we have young medical graduates serving full-time for 15 months compulsory military service, shortly after qualification. I would like to deal with these first.

#### MEDICAL OFFICER TRAINING

After basic military training, both as officers and in general military medicine, they have a six-hours a day, three-week course in aviation medicine at our Institute of Aviation Medicine. In comparison with many other nations this is a relatively short period of instruction. There are several reasons for our approach. In our consideration of aviation medicine we omit much detail from technical matters, such as hygiene, medical examinations and hyperbaric and diving medicine. We exclude space medicine. Without going into details of our syllabus, I would like to mention a few points.

We consider important, and put much emphasis on orientation about NATO and AGARD and the Aeromedical Institutes of friendly countries. A pilot teaches about aircraft in use and flying in general. We call upon special consultants to the Air Force for teaching about problems in dentistry, hygiene, ear nose and throat, noise and epidemiology whilst the few doctors on the staff of our Institute have to cover all other aspects of aviation medicine. Often their background is not entirely adequate because they rarely stay at the Institute for a long period. Personally, I have had the difficult job of teaching the entire range of subjects. We are not able to have a full staff of people qualified in all the different fields of aviation medicine.

In our course we give special talks and demonstrations about visual problems and flash, as recommended by this panel. We carry out decompressions runs, as described later, and for the young doctors entering compulsory service we have reserved time for lectures and practical exercises on tracheal intubation, resuscitation, etc..

We make use of several textbooks as teaching aids for lectures and we have compiled a special book of our own, based upon various handbooks, journals and reports etc.. In this we deal with all aeromedical topics in a brief manner, quoting numbered paragraphs and sub-paragraphs, to which it is easy to refer. Slides and placards are numbered also in accordance with the same system. Films are not used much, and I would like to put forward the opinion and hope that the production of teaching films for use by NATO countries could be better co-ordinated, perhaps together with videotape programmes, by this AGARD Panel. We have no regular post-graduate training programmes or degrees or diplomas, but arrange continuation training as and when needed. We have also had the good fortune to be able to participate in courses held in friendly countries.

Turning now to other categories of aeromedical training to be dealt with in this meeting, I do not know of any specific industry in this field in Norway, and we therefore have no opportunity for co-operation with designers and engineers. The local Aeromedical Association holds meetings, but naturally the number of participants is rather small. Doctors serving with our Army and Navy have no special training in aviation medicine apart from a few lectures in our Institute. Industry, aeromedical licencing authorities and our Directorate of Air Transport have no regular indoctrination or teaching, as far as I know.

#### FLIGHT NURSE TRAINING

Flight Nurses are recruited from civilian hospitals and civilian organisations on a voluntary basis and are given a three-week course, four hours a day. In the event of a war they would serve as military flight nurses. Once they have completed initial training they have no routine or regular refresher courses.

#### PARA MEDICAL PERSONNEL TRAINING

Non-commissioned medical personnel in the Royal Norwegian Air Force have no regular systematic training in aviation medicine, but we teach them where there is a special need, as for example, in the case of decompression chamber operating crews. Many such groups of personnel are issued with special approval for their particular duties after completing training in our Institute of Aviation Medicine.

#### AIRCREW TRAINING

To deal next with aircrew, pilots are given their initial aeromedical training in the USA whilst attending primary flight school. On their return to Norway they have a short orientation course and testing of their personal equipment carried out by a personal equipment officer, and at our Institute, where they later in their careers are given aeromedical instruction in accordance with STANAG 3114. This course is repeated at least every three years. We devote two days to

the syllabus rather than the one day specified in the STANAG, and are thus able to deal with the topics in greater depth. We do not give courses as a matter of routine on changing aircraft type or equipment, or after accidents or incidents, preferring to leave this to be dealt with at station level.

Regarding the terms of STANAG 3114, I would like to challenge the possibility or desirability of attempting to deal with so many large and important topics in one programme. Is anyone able to give lectures on survival in all climatic conditions, hypoxia, dysbarism, acceleration, sensory illusions, escape, hygiene, personal equipment, give a chamber run and hold an examination, all in one day? We find it impossible, even in our two-day course and prefer to skip some subjects and go more deeply into others. Older and more senior pilots will find it tiring and tedious to deal repeatedly with the same subjects at a very superficial level, and we have therefore tried for this group the experiment of dealing in detail with a restricted field, such as hypoxia and illusions in one course, and then, three years later, to discuss accelerations and dysbarism.

Being a small nation within a large geographical territory and but one Institute of Aviation Medicine, we have to treat some of the STANAG topics at station level. I do not intend to deal here with our survival training.

For a period of several years we carried out testing and training in flight with regard to sensory illusions, as have other nations, but we have not found it to be sufficiently rewarding to be continued. We routinely use the Martin Baker ejection training rig.

In addition to the refresher courses at our Institute, aircrew have 10-11 hours of training every year at their stations, with a varying programme in accordance with direction from the Surgeon General, and co-ordinated with the training lectures at the Institute. Other aircrew members, loadmasters, engineers and navigators have the same refresher courses and training at station level as do the pilots.

Lectures and continuation training for civilian crews are the responsibility of the airlines and I am unaware of any special regulations about routine teaching.

For several years we gave chamber runs to 40,000-42,000 feet but we now have a revised procedure, not going above 22,000 feet. An explosive decompression from 8,000 to 22,000 feet is performed and each person is given an individual test, is taught about hypoxia and pressure breathing is demonstrated at altitude. We do not give any night vision demonstrations.

TEACHING OF AEROSPACE MEDICINE IN THE MILITARY AND CIVIL FIELD IN ITALY

by

Brigadier General Professor Arist. de Scano, IAF, MC

Italian Air Force  
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#### ABSTRACT

Teaching of Aerospace Medicine in Italy has long been carried out, at different levels, concerning both military and civilian medical and auxiliary personnel, as well as flying personnel.

The courses sponsored by the Italian Air Force Medical School are the following:

- Basic and refresher courses for Medical Officers on permanent duty, and temporary Medical Officers of the Italian Air Force.
- Basic and refresher courses for auxiliary sanitary personnel in the Air Force, and for Flying Medical Assistants and Nurses (also on behalf of the Italian Red Cross).
- Aerophysiological indoctrination of the Italian Air Force Personnel, in particular Flight Safety Officers (the latter course being sponsored by Air Force Staff). Short survival courses are sponsored by the Flight Safety Department.

A two-year postgraduate course of Aerospace Medicine is performed in the Medical Faculty of the University of Rome. Such a course bestows a specialist certificate.

In the same University, a few informative lectures are also delivered to Aerospace Engineering students.

Alitalia medical personnel are entrusted with basic aeromedical information to be given to airline pilots, and with some elements of first aid to be given to hostesses and stewards.

At present the courses for Medical Officers held under the direction or with the collaboration of the Military School of Aviation Medicine, which has its headquarters in Rome at the Study and Research Centre for Aviation and Space Medicine, are as follows:

**A. For Personnel on Permanent Duty**

**1. Professional Course for Lieutenants on permanent service in the AF Medical Corps**

This course is open to winners of a public competition for which qualified medical graduates under 32 years of age are eligible. The course represents the basis of professional training in aviation medicine. It is generally annual and lasts for six months in all. The first 40 days are dedicated to the teaching of military subjects (regulation of discipline, organization, etc., and to military instruction - the participants, in fact, may come from civilian life); the other four and a half months are spent on the teaching of professional subjects, shown in Table I, for a total of over 400 hours including lectures, demonstrations and laboratory work. The course is concluded by final examinations which may partly modify the order of merit of the competition. For the practical part of the course, recourse is had to the specialized equipment of the Study and Research Centre for Aviation and Space Medicine and also that of other departments of the Air Force Medical Service. The teachers are all Air Force Medical Officers, specialists in the various medical and surgical branches and in aviation and space medicine, many of them being qualified University lecturers.

Some lectures on the latest scientific developments are delivered by members of the permanent University staff.

**TABLE I**

**PROFESSIONAL TEACHING IN THE COURSES FOR I.A.F. MEDICAL OFFICERS**

BASIC TEACHING	SUBSIDIARY SUBJECTS AND PRACTICAL EXERCISES
Aviation Physiopathology	Aviation Physiological Technique
Hygiene and Aviation Occupational Medicine	Flight Accidents Survey
Psychology and Ergonomics Applied to Flight	Otorhinolaryngology Applied to Aviation
Aviation Forensic Medicine	Nuclear, Biological and Chemical Warfare Protection
Air Force Health Service	Ophthalmology Applied to Aviation
Aviation Traumatology and First Aid	Neurology and Psychiatry Applied to Aviation
	Laboratory Work

**2. Refresher Course for Captains of Air Force Medical Corps**

This course came into being 10 years ago to meet the needs of Officers who, for service reasons, spend several years at the Air Bases, losing contact with the University and with the School of Aviation Medicine.

The present course lasts only 40 days (the first ones lasted for 6 months) because it is not possible to take many Officers away from service for much time. For this reason, it was found more convenient, from the 8th course, to have one course in spring for half of the audience and another course in summer for the remaining. In accordance with its principal aim, most of the hours are dedicated to daily attendance at University Institutes in the medical and first aid and resuscitation departments, the Officers being inserted in the activity of the latter under the guidance of the permanent personnel. Lectures and practical work at the School are limited in number (about 50 hours for the whole course) and the teachers deal only with the subjects in which there have really been new developments in theoretical knowledge, new applications, the use of new materials etc. Teachers at this course are also military. The course that is going on at present has among its students a Medical Officer of the Congolese Air Force.

**3. Course for Flight Surgeons**

This course was instituted in 1952, and ten were held, until 1966. The course, which is suspended at present, lasted 5 months, took place in the framework of the Study and Research Centre for Aviation and Space Medicine and had the aim of giving a more thorough preparation in aviation physiology, psychology and hygiene, and, particularly, to form that frame of mind that makes the flight surgeon one of the most effective factors in the efficiency of the pilot and in flight safety. During the course, the students attended the laboratories of the Centre and received the necessary training to learn use of the low pressure chamber and teaching methods for pilots, in order to be able to give courses in aerophysiological indoctrination at the air bases. They had also to prepare an experimental thesis under the guidance of researchers in the various departments. The course was open to professional Medical Officers from the rank of

Lieutenant to that of Major, volunteers. In the past years it was attended also by Medical Officers from other countries (Argentina, Venezuela). Action is being taken to resume these courses.

#### B. For Temporary Personnel

Training courses for medical cadets on temporary service in the Air Force

Graduates in medicine who wish to do their military service in the Air Force take part in these courses. They last for about three months and include military training, physical training and about 100 hours' teaching in military culture. The professional part consists of about 160 hours' lectures and laboratory work on the same subjects imparted to the permanent staff, with final examination. The course takes place in Florence, at the Air War College and is entrusted to military teachers.

Before going on to give other details of an organizational character on the teaching of aviation medicine, we think it useful to recall some teaching problems characteristic of our discipline, which extension to elements of space medicine has stressed further. As experts taking part in the symposium are well aware, it is a composite subject matter, the roots of which are essentially physiological and physiopathological, from the trunk of which many branches, large and small, have come forth. It follows that the teaching staff is usually composed of many specialists, each of whom deals with a small part of his specialty, the part, that is, connected with flying. It is difficult, in fact, for the teacher of aviation physiology to deal, for example, with the clinical aspects of barotrauma or the traumatological aspects of escape, with the competence of an otologist and a traumatologist respectively, exercising their specialty in the Air Force. Therefore it is necessary to have at least ten highly specialized teachers on the permanent staff of an aeromedical school, and as this is difficult in Italy, a compromise is resorted to, that of sending them there periodically from their place of work during each course.

The multiplicity of subject matters may lead to the opposite drawback, namely the repetition of the same chapters by different teachers or else the failure to deal with part of the programme in the reciprocal conviction that another teacher is dealing with it.

In our School we try to avoid these drawbacks by means of careful programming. For this reason, too, teachers are asked to hand in a written synthesis of their lesson 24 hours before it takes place. If the subject is one in which no new developments have taken place (which rarely happens in our field), the synopsis of the preceding year is used. This method, which calls for a greater effort on the part of the teachers, is rather unpopular, but it has proved to be clearly effective on the teaching plane. The synopses, in fact, are stencilled in the number of copies necessary and distributed among the students before the lesson. The student can complete them with notes and keep them for revision or to update the texts (books and lecture notes) that he is given free of charge at the beginning of the course. This makes up, in part, for the quick obsolescence of medical treatises in general, and, in particular, of aviation medicine books. Such an obsolescence is not only due to the advances of sciences, but also to the stickiness with which out-of-date information persist in medical literature, being replaced by new acquisitions only with a delay of several years.

These courses also require facilities of considerable complexity and cost, ranging from low-pressure chambers to thermic chambers, from human centrifuges to deceleration tracks, vibrators, etc. This problem has been solved in Italy, as in most countries, by placing the School in the buildings or in the neighbourhood of a research Centre (and this method also ensures a fair number of teachers and lecturers who are really up-to-date in the most advanced fields of research).

After these general considerations, we will pass to courses for non-medical military personnel: they concern the auxiliary personnel of the Medical Corps (non-commissioned officers and Medical Corps Adjutant troops and flying personnel, particularly those in charge of flight safety).

For the training of Air Force Medical Corps medical attendants and technicians (in radiology, dentistry, ophthalmology, audiology, etc.) there exists a School at Taranto, at which non-commissioned officers of other technical specialties are also trained.

In the case of Medical Corps Adjutants there are three successive courses; the first (normal course, for enlisted men) provides the basic training and lasts for about 6 months; the second (complementary course, for sergeants) aims at consolidating and updating technical training and lasts 3 months; the third (specialization course, for warrant officers) lasts 3 months.

In each of them, together with the elements necessary for the training and specialization of military medical assistants, the main elements of the physiopathology of man in flight are imparted, with special stress on care of the sick in planes and of wounded persons transported by air, and on first aid in flying accidents.

In order to improve it, we have recently implemented the teaching aids, films, etc. and are about to try out a teaching machine (Mastermatic) for revision of the most difficult subjects, individually or in groups of not more than three pupils.

As regards the pilot crews, STANAG 3114 is applied. The two mobile low-pressure chambers at the disposal of the Air Force Medical Service are circulated according to a programme drawn up in agreement with the air base headquarters. A special course of Aero-physiological training was also held every year at the Study and Research Centre for Aviation Medicine from 1956 until 1965. It lasted about 20 days and was intended for Pilot Officers with special responsibilities (Wing Commanders, Squadron Leaders, Flight Safety Officers, Instructors).

It has been replaced by a course for Officers responsible for flight safety. This course, which began in 1964, is sponsored by Air Force Staff. It takes place annually at the Air War School in Florence and lasts for about 2 months.

In both cases the aeromedical part comprises about 40 hours of lectures and demonstrations on physiology and aviation hygiene and psychology applied to flight with special reference to the human factor in accidents and their prevention.

Teachers at the basic and refresher courses envisaged by STANAG 3114 are the flight surgeons of the various air bases, while the course on flight safety is given by military teachers who go to Florence on days when they have lectures. There is a short text-book for the latter course.

The pilots attend, in turn, a brief annual course on survival in the mountains (months from October to March) and on the sea (months from May to September). In this case, too, the physiological aspect of survival is dealt with by a flight surgeon.

Finally, in the years 1961 and 1963 two courses of preparation for Medical Assistants of the Air were held, in accordance with the provision of the Fédération Aéronautique Internationale.

These courses, which lasted for about 40 days, were attended by non-commissioned officers of the Medical Corps and by volunteer nurses (female) of the Italian Red Cross. At the end of the course, they awarded the relative international certificate.

In the civil field, too, the desire for an aeromedical school was expressed as early as 1941 by Agostino Gemelli in a well-documented article "On the necessity of teaching aviation medicine at the University". But it was only in 1963, with a decree of the President of the Republic on January 23rd of that year, that a real post-graduate school was set up at the University of Rome. It has the aim of promoting the development of Aviation and Space Medicine, training graduates in medicine and surgery for the tasks of attending to the civil flight personnel in land and during flight, and awarding a diploma qualifying the holder to exercise this discipline with the title of specialist.

The specialization Courses in Aviation and Space Medicine last for two years and are held in the School of the same name. The latter formerly had its premises in the Institute of Medical Pharmacology but has now moved to the Institute of Forensic Medicine of the University of Rome, which has more space. The lessons, which are imparted by Professors of the University of Rome and Medical Officers of the Air Force qualified to teach at Universities, are both theoretical and practical in character and deal with numerous subjects of aeromedical interest, particularly human physiology, the physiopathology of man in flight, aviation physiological technique, hygiene, forensic medicine, the physics of atmosphere and space, the mechanics of flight, radiobiology, etc.

Other subjects dealt with are psychology, ophthalmology, otorhinolaryngology, neurology, pharmacology, first aid, occupational aviation medicine. There are also visits to airports and practice flights.

Altogether, there are 254 hours of lessons and laboratory work every academic year. In the academic year from 1963 to 1964 53 graduates in medicine and surgery were enrolled and attended the School. In the following years the average number of students was about 15, with a tendency to drop.

The School has also organized a series of experimental and statistical researches carried out by the students and presented in their specialization theses.

The courses held so far have mainly been attended by civil physicians working on their own, and Medical Officers of the Air Force. Some Medical Officers of the Navy and of the Police and physicians employed by Alitalia and the Ministry of Transport and Civil Aviation were also enrolled.

The cost of upkeep and of running the School is met by the sums paid annually by the students as fees and by contributions from the Ministry of Defence (up to 1968), Alitalia, the Ministry of Transport and Civil Aviation.

The engineers attending the Faculty of Aviation Engineering of the University of Rome have a small number of lectures on flight effects on the organism, delivered by the rector of the Specialization School mentioned above, but there is no organic treatment, particularly of aerospace ergonomics.

As regards the personnel of the airlines, they have been following for various years a very short course (9 hours) given by a specialist in aerospace medicine belonging to the Alitalia medical service. Lectures are accompanied by films and at the end of the course there is a written examination in the form of answers to questions set by Officials of the Ministry of Transport and Civil Aviation with the participation of an expert of the Air Force Medical Corps.

Hostesses and stewards attend a short practical course such as is given to nurses, given by the same specialized medical personnel of the Alitalia Medical Service. According to the information we have received, it consists only of practical training on how to use the drugs contained in the first aid kit on board.

In conclusion, it can be said that, thanks especially to the initiative and capacity of doctors of the Air Force Medical Corps, Italy has at its disposal sufficient organizations and facilities for the training of Medical Officers for the Air Force and civilian specialists in aviation and space medicine as well as of equally qualified medical auxiliaries for service in the Air Force.

### Section I: General Discussion

Mr. Sir Johnson (RAF) opened the discussion by raising the question of the results of pilot training for doctors. Were count men achieving good doctors, good pilots or both?

Major Perry (British Army) thought that pilots could remain competent by their own national standards, perhaps by 10-15 hours flying monthly and have sufficient time left to maintain their professional standards in medicine. He felt that there was an undeniable need for Medical officer/Pilots in order to achieve optimal contact between aircrew needs and aeromedical opinion.

He asked also whether the German Air Force gave any flying training as part of their Primary Flight Surgeon's course.

Major Garbe (GAF) replied that this was not available.

Lt Col Verheij (R Neth AF) commented that the Netherlands appeared the only country bringing its primary aviation medicine course students to near-solo or actual solo standards of flying training.

Major Burden (RAF) mentioned that a novel approach was being tried in Canada, namely the proposal to train suitable aircrew officers in medicine.

Major Caput (USA) stated that it was hoped that in the near future it would be possible to train all US Army Flight Surgeons as rotary-wing pilots.

Dr. Rutenfranz (Germany) noted that there had been many comments regarding the lack of adequate textbooks. What books were in general use?

Professor Scano (IAF) stated that in Italy there were adequate publications; a three-volume "Treatise on Aviation Medicine" (1942) by Lomonaco, Gemelli and Margaria and the more recent (1959-1965) three-volume "Aviation Medicine and elements of Space Medicine" by Lomonaco, Scano and Lailli. There are also texts on other subjects, such as hygiene, psychology etc. which are handed out at the Military School of Aviation Medicine.

Major Burden (CAF) stated that the Canadian Forces were making use of the recently published US Navy Flight Surgeons' Manual.

M. Cdr Fryer (RAF) commented on the value of gathering information on the form of training given to Flight Surgeons and their equivalent in various countries, and the subsequent employment opportunities. He proposed, as Editor of the forthcoming Proceedings of the meeting, to collect and collate relevant data and publish these in tabular form. The results are shown in table I.

CIVIL AEROSPACE MEDICAL ACTIVITIES IN GERMANY

by Erwin A. Lauschner  
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Fürstenfeldbruck - Germany

S U M M A R Y

It can be stated that an increasing number of medical and technical faculties are including aeromedical subjects and lectures in their teaching programs. The main civilian aerospace medical activities are concentrated in the Institute of Aviation Medicine of the G.A.F. and its civilian counterpart, the German Aerospace Medicine Association. A large part of the postgraduate training program for medical doctors is provided by these institutions. "Lufthansa" has finally its own aeromedical service. The situation in the German aircraft industry is still deficient but improving.

Before and during World War II Aviation Medicine was an important subject in many German Medical Faculties. Some of the ancient authors such as Strughold, Claman, Luft, Gauer, and von Diringshofen are still known today.

After the War there was a stop of more than ten years in all activities pertaining to aircraft industry, aeronautical sciences, and therefore, also in aviation medicine. This fact opened a great gap as far as these sciences were concerned. Only in the late fifties Germany started to build up again its own aircraft industry, and, simultaneously the Technical Faculties included aeronautical and later on also aerospace research and instruction in their teaching programs. At that time nothing happened in the field of aerospace biology and medicine. Only in Bad Godesberg existed since 1952 a small Aeromedical Research Center directed by Professor Ruff, and belonging to the German Experimental Establishment for Aeronautical and Space Research (Deutsche Versuchsanstalt für Luft- und Raumfahrt). In 1959 the new German Air Force started its own "Institute of Aviation Medicine" in Fürstentfeldbruck - Bavaria. Both Institutes tried to become nuclei for broader research activities in Aerospace Medicine, and to interest Medical Faculties at the German universities in their problems. It was quickly realized at that time that knowledge in the field of Aviation Medicine, and far more in the new field of Space Medicine had made a tremendous progress, and that it would be rather difficult to compete effectively with this fast progressing knowledge. It was also realized that these two Institutes alone would not be able to cover the entire spectrum of Aerospace Medical Research, and that the help and interest of as many Medical Faculties as possible should be searched. This process is still going on, and first results are coming up.

Research, however, is only one part of the problem. Teaching and indoctrination of medical students is the other side. Today's students will be tomorrow's scientists. They have to be brought into contact with the current aerospace medical problems early in their professional life in order to stimulate their interest, and to direct their activities into the way desired.

There are a few other disciplines in the German medical world having the same goal and also the same difficulties in realizing it. These are "Industrial Medicine" (Preventive Medicine), and "Social Medicine". Industrial Medicine has recently been recognized by the authorities as a special medical branch, not yet as a special discipline of its own. It is lectured in about ten medical faculties, and after an appropriate postgraduate training a diploma is being issued. Social Medicine is still a rather vague item. Aerospace Medicine lies in between. As already stated, on the military side it is a recognized branch with a fixed postgraduate training schedule and a diploma. On the civilian side there are about 300 aeromedical examiners authorized by governmental authorities to examine civilian pilots of Cat. I, II and III, but until now there are no special professional training requirements laid down for getting such an authorization. Needless to say that here is a gap to be closed.

The professional training situation can be subdivided into three categories:

- a) Training at the Medical Faculties before the final examination;
- b) Postgraduate training of M.Ds;
- c) Training of technical students in special aerospace medical problems and human engineering.

As far as the Medical Faculties are concerned

- 19 out of 21 have answered our questionnaire;
- 4 of them are offering special lectures on Aerospace Medicine;
- 6 are dealing with some aerospace medical subjects, in general physiology, forensic medicine, ENT, and other disciplines;
- 9 are doing nothing at all in this field.

As far as students of Technology are concerned there is a drive to include "human engineering" into the classical lectures. With regard to Aerospace Research the situation is as follows:

- all 8 Technical Universities have answered our questionnaire;
- 5 of them are offering special lectures on medical and human factor problems in connection with aerospace technology;
- 1 is doing so partly;
- 2 are doing nothing at all in this particular field.

The course programs of the special lectures on Aerospace Medicine are mainly concerned with the classical chapters:

- Physics of the atmosphere;
- Aerospace physiology;
- Clinical Aerospace Medicine;
- Aerospace Psychology;
- Aerospace Pathology;
- Preventive Aerospace Medicine;
- Human Engineering;
- Life Sciences.

As far as the program for students of Aerospace Technology is concerned emphasis is laid on all problems of Human Engineering and on the special technical problems of the other chapters.

So far the lectures at university level. As it can be seen, the first effort is made but much has still to be done.

The second part of this paper deals with the possibilities of postgraduate training for medical doctors and specialists. Here, the main activities are concentrated in the two Institutes already mentioned, and especially in the German Aerospace Medical Association.

The by-laws of this Association state that its main goal is to promote and cultivate theoretical and applied Aerospace Medicine and all connected disciplines by

- organizing conventions, symposia and regional meetings;
- editing publications pertaining to Aerospace Medicine and biology;
- constituting and supporting interdisciplinary research teams;
- keeping close contacts with the appropriate Institutes and Associations of other countries.

The "Deutsche Gesellschaft für Luft- und Raumfahrtmedizin" has four different working groups to deal with

- aircrew selection and survey;
- medical problems in air traffic control;
- space medicine and biology;
- problems of hypobaric and hyperbaric pressure.

Both, the Institutes and the Association are providing speakers for many Medical Congresses and for the regional postgraduate training programs. They try hard to promulgate the current status and recent results of aerospace medical research, and to stimulate the interest of the average German medical doctor. It is to be said that this policy proves to be more and more successful, in particular with regard to problems of clinical and preventive aviation medicine. Naturally, the last spectacular events of the Apollo program have caused a huge wave of interest of the medical world in the problems of space medicine. A good indication for this fact is the increasing number of requests for papers and communications submitted by medical societies and other organisations. The number of students attending the lectures on aerospace medicine is still small but steadily increasing.

Finally, this paper will discuss briefly the aeromedical activities deployed in the German aircraft industry. The trend for fusions within the different groups is well-known, and in the interest of common survival. This, of course, diminishes employment possibilities for aeromedical specialists. Anyway, Human Engineering studies in Germany are currently carried out by either engineers or groups of engineers. Only one company has a trained aviation psychologist and a medical doctor without special aeromedical training in its group.

The tendency of firms to contact the Institute of Aviation Medicine GAF in order to get solutions for arising human factor problems is increasing. The problems themselves are also more often recognized. But much seems still to be done to create sound and adequate relations.

The German commercial airline "Lufthansa" restarted its activities more than 14 years ago. But only this year they are building up an adequate aeromedical service of their own, having relayed before on contracts with local doctors and on a small general industrial health service. The main flight surgeons of "Lufthansa" are reserve medical officers of the Luftwaffe, and received their special aeromedical training at the GAF Institute.

THE DIPLOMA IN AVIATION MEDICINE OF THE  
ROYAL COLLEGE OF SURGEONS (ENGLAND) AND  
ROYAL COLLEGE OF PHYSICIANS (LONDON)

by

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SUMMARY

The basic requirements of training required for candidates taking the examination of the Diploma in Aviation Medicine of the Conjoint Board are described. The format of the course of instruction at Farnborough is considered and problems are outlined.

### Origins

In late 1966 the Conjoint Board of the Royal College of Surgeons and Royal College of Physicians set up a Working Party to consider the possibility of the initiation of a Diploma in Aviation Medicine. In this group were represented the three Armed Services, the Joint Air Corporation's Medical Service, the Board of Trade (which controls Civil Aviation in the United Kingdom), the Royal Colleges themselves, and their Examining Board. As a result of two meetings of this group an announcement was made early in 1967 to the effect that the first examination for the Diploma would be held in 1968. In July of this year the third such examination will be held, and it is now convenient to summarise the aims and objectives of the Diploma and the results so far.

It is of interest to recall the discussions which took place at the meetings of this Working Party. The first, and perhaps the most difficult decision of all, was to define Aviation Medicine. No really simple definition can be made because there are many facets to the subject which were considered essential parts of a Diploma examination. Perhaps it would be better to reiterate what was written into the minutes of the meetings, namely that the Diploma was designed as a recognition of competence in the field of Aviation Medicine. The subject itself, it was decided, would include the study of the environment in which man flies, the equipment with which he achieves flight, the man/machine relationship in aviation, the physiological effect of flight, and the influence of disease upon a career in aviation.

### Aims

Why did the United Kingdom decide to initiate a Diploma when other qualifications already existed? Not only was there the American Board Certification in Aerospace Medicine but also there was already a Diploma in Industrial Health and it was argued, quite forcibly, that aerospace medicine or aviation medicine is really only an extension of occupational or industrial health. The answer lies in an appreciation of what constituted competence in this field. It was felt that, as with other British Diplomas, the qualification should not necessarily be an indication of competence as an unsupervised research worker, or as a senior practitioner, but an indication that the individual has displayed an ability to master the fundamental aspects of his subject in its full width. To amplify this, it was specifically decided that our qualification would differ in two marked respects from those awarded in other countries. Firstly, the aspects of public health would be restricted to those directly affecting the aviator working from a permanent prepared base. Secondly, the training in clinical skills would lead to knowledge of the common and important diseases affecting aviators and the influence of disease upon a flying career without aiming at expertise in unsupervised ophthalmic refraction, electrocardiography, electroencephalography and so forth.

Bearing these qualifications in mind it was considered that the examination should be open to those with adequate experience in aviation medicine (3 years full-time or 6 years part-time) or to those with little experience (one year full-time) but satisfactory completion of a course of instruction. The RAF Institute of Aviation Medicine was recognised as a place competent to organise such a course but it must be emphasised that it is open for any teaching establishment to apply to the Conjoint Board for registration as a suitable place for a course of instruction leading to the Diploma. One academic year was considered to be the minimum period for the course, but experience of the first year showed that with careful planning a course adequate for the syllabus of the Conjoint Board could be completed in six months, although it must be confessed that the pace at which such a course is conducted is hard on both pupils and staff.

### The "Diploma Course"

To consider the course itself, it is convenient to divide the instructional periods into two halves, the basic sciences and the clinical phase. The approximate breakdown by subjects in the basic sciences is given in Table I.

TABLE I - Basic Studies

	Hours
Aerodynamics, Physics etc.	8 $\frac{1}{2}$
Assessment of Scientific Evidence.	1
Climatic Physiology.	13 $\frac{1}{2}$
Neurophysiology.	9
Vestibular Function.	8 $\frac{1}{2}$
Survival.	13 $\frac{1}{2}$
Altitude Physiology.	40
Acceleration Physiology and Escape.	30 *
Noise	10 *
Aircrew Equipment and Clothing.	8
Psychology.	40 *
Toxicology.	5

\* Includes Visits

### Basic Sciences

What are the aims of the first three months? It is sometimes difficult to remember that people attending for a course of instruction with one or two years experience in the field may have very little knowledge of the fundamental background of the environment of flight and the task of the aviator. It is vital that anyone practising aviation medicine should inspire confidence in his patient. To this end it is essential that he should be able to speak "the language of the aviator". There is nothing more detrimental to the confidence of a patient or interviewee than the feeling that the two people involved do not have a common basic vocabulary. We would like to give each pupil a comprehensive course on aeronautics, backed by a period of flight instruction, and we are most envious of those nations which manage such a programme. We find it prohibitive in both time and expense and therefore attempt, perhaps not yet with optimal success, to demonstrate by lecture and film and by visits to the airfield, those features of modern aircraft and their operation which will exemplify the tasks given to the aviator and the way in which the aircraft is configured to enable him to fly to the limits of its performance.

Another aspect where we would like to give more time is in refreshing the student's knowledge of modern physics and mathematics. The level of competence varies more in respect of these subjects, than any other and it is therefore naturally difficult to instruct the less well versed without running into problems of boring the more erudite. However, we seem to manage to achieve considerable success with a few hours of simple lectures on gas physics, the basics of fluid dynamics, measurement and units, and, in the appropriate lecture series, optics, radiation, acoustics etc.

Of all the subjects which confront the medical practitioner, few if any can vie with statistics in the establishment of an immediate antagonism. No matter how good the instruction or how carefully the programme is directed towards relevant application, students seem almost universally to be averse to instruction in this subject. Yet, none can deny that a large proportion of scientific evidence presented in the literature reveals incompetence on the part of the workers in the adequate design, reporting, and analysis of results of experiments and it is regarded as absolutely essential that students should leave the course with sufficient knowledge to enable them to assess the merits of published work. In the 1970 course we have completely redrafted the instruction in this subject and have even gone to the extent of renaming the topic as "The Assessment of Scientific Evidence". We have emphasised the modes of collection of data, graphical expression, tabulation, and the meanings of such terms as population, sample, variation, randomness, and probability. Although the pace has been slow, we feel that we have achieved a much higher level of success than in the past and there has even been evidence of enthusiasm among the students when confronted with obviously relevant problems as examples. We have not attempted in any way to instruct students in actual computational techniques, which we consider to be a matter for experts or for individual enthusiasts to study in their own time.

The basic physiology of aviation has presented few problems. We have available an excellent team of specialists in the various fields of aviation physiology at Farnborough, and our main difficulty has been in curtailing their enthusiasm and limiting the depth to which they wish to instruct in their individual subjects. We have given a limited number of practical demonstrations and allowed the students to carry out experiments themselves. We would like to allot more time to practical work but it is very difficult to justify the allocation of long periods during a course with such a tight schedule. The time-table is generally arranged in such a way that each subject has no more than one period each day but that a whole topic is covered in a matter of two or three weeks; this introduces an element of variety into the day, so essential if an individual student finds a topic boring.

In parallel with the aviation physiology we try to instruct in the psychological aspects of aviation and here, as with statistics, we come against some form of emotional barrier. It is no doubt a reflection of the lack of teaching of psychology in medical schools that qualified physicians seem unable to arouse enthusiasm for academic psychology. Considerable interest is engendered by discussion of practical problems in aviation psychology like the presentation of information by instruments, selection tests, and the assessment of opinion by questionnaires, but there is generally a high degree of intolerance to instruction on the fundamental aspects of psychology of perception, personality, behaviour, decision-making and learning, which are the foundation stones of applied aviation psychology. The psychologists who are concerned with the teaching quite rightly insist that they must give adequate instruction on the fundamental background if they are to avoid the engendering of the concept that aviation psychology is no more than an artisan skill. It must be acknowledged, however, that a course of instruction which meets with resistance on the part of the student is inadequate and therefore we must continue to strive to improve this vital part of the course. How this may be achieved is a subject of quite spirited discussion. As with statistics, it is generally felt that instruction by or to a detailed plan drawn up by medically qualified personnel with a knowledge and understanding of the more fundamental science is more acceptable to students than direct instruction from specialists but it is hard to find such instructors and, if they are forthcoming, difficult to persuade the experts that the standard and quality of instruction which will be given is adequate.

### Clinical Phase

Next, we must come to the clinical subjects (Table II). Here we have encountered a fundamental difficulty which is the reverse of that which we met with in the basic sciences.

TABLE II - Clinical Phase

	<u>Hours</u>
General Clinical Subjects.	18
Neuropsychiatry.	5
ENT.	8*
Ophthalmology.	14*
Tropical Medicine and Hygiene.	20
Aviation Pathology.	17
Medical Standards etc.	9
Civil Aviation.	23
Agricultural Aviation.	2

\* Includes Visits

It has been found difficult to elicit from individual consultants material which they regard as relevant, whereas, you will recall that, in the basic sciences it was often hard to restrain teachers from going into too much detail. When one comes to analyse the subject, apart from the eyes, the ears and sinuses and the psyche, most systems of the body are extremely resistant to the effects of the aviation environment and thus we are left predominantly with the influence of disease upon the aviator's career. This may be learned by the commission to memory of tables of disqualifying conditions, but this is not what we aim to teach our students, since they should have all this information available in brief manuals at their desks. What should we be teaching them?

Here we find ourselves torn between two aims. At one extreme there is the "mini expert" who can examine a patient, carry out specialised investigation of the electrocardiogram, the psychiatric state, the condition and refractive errors of the eye, and all the aspects of physical examination which may be necessary in the selection and periodic examination of aircrew. At the other extreme there is the concept of a Field Medical Officer who knows when a man may or may not be allowed to fly but refers any case of difficulty to a relevant specialist. We set our sights on a target midway between the two. As an aid to clinical teachers we have devised a formula which we hope will enable them to construct a relevant course of instructional lectures and demonstrations. Basically these are:-

1. What are the common and important diseases of aviators, both spontaneously occurring and induced by aviation, which may affect his career?
2. In the case of a commonly occurring observation which arouses a suspicion of abnormality, for example proteinuria, glycosuria, hypertension, etc, what degree of investigation should be carried out at a peripheral medical establishment before a case is regarded as being within normal limits, or requiring consultant advice on diagnosis and treatment?
3. In the case of the important and serious conditions affecting aircrew, what treatment, surgical or medical, is used to correct or control the disease process and how is this going to affect the man's ability to carry out his duties in the air? In the case of unconfirmed diagnosis, what further observation and investigation will be required of the general practitioner?

This formula would appear to enable clinicians to construct an adequate series of lectures and demonstrations and we divide our teaching between presentations at Farnborough and practical experience at the Central Medical Establishment, the Aircrew Selection Centre and other specialised establishments. A large share of the available time is rightly given to those three aspects of medicine which are most commonly involved in the rejection of aircrew candidates and the interference with an established flying career. These are diseases and abnormalities of the eye, diseases of the middle and inner ear and paranasal sinuses, and the psychiatric disturbances. We rely heavily upon Royal Air Force consultants for instruction in all subjects but we also have very valuable periods of tuition from members of the medical staff of the Board of Trade, the Air Corporations, and other experts in particular fields. These include such very important and expanding subjects as agricultural aviation and toxic chemicals.

It is all too easy to develop in the students an impersonal attitude framed by a set of rules and regulations with disregard for the more sociological aspects of the subject. We therefore lay great stress on the implications of career interruption and to this end we invite Service and Airline pilots to come and give their views on fitness to fly. We also make considerable use of discussion groups and symposia on such debatable topics as the compatibility of minor disability with flying, the meaning of physical fitness, the effects of ageing, and positive health control. It is no doubt becoming clear to the audience that our ideal graduate is thus in some respects a different person from the graduate of such a course as the US Board Certification Programme. Perhaps I can help to clarify the reasons for our differing approaches.

Our graduate is expected to have two fundamental skills. Firstly, he should be able to recognise mental and physical disease in an aircrew population at the earliest possible stage, investigate it within the limitations imposed by the equipment at a small Medical Centre, and realise when, having reached the extent of his skill and knowledge he would need to refer a case to a Clinical Consultant. Secondly, and this is particularly relevant for students from less developed nations, when the aviator is returned to his unit with the clinical opinion of a Consultant, the graduate should be able to assess the implications of that opinion with regard to the man's career both in terms of his immediate return to flying, or temporary suspension, and his long-term employment in aviation. It is essential to realise that few countries can boast aeromedically informed clinical consultants. If our student can grasp these two basic aspects of aviation medicine, we consider that we have achieved our aim.

#### Miscellaneous Topics

Finally, we have a miscellaneous group of subjects (Table III) which include many fringe topics of which an aviation medicine practitioner should have some basic knowledge. It is not easy to decide on the depth of instruction which is justifiable in so short a course. Among the more important are the standards, selection, and medical care of Air Traffic Controllers, aspects of flight safety and accident investigation, radiation biology as encountered in aviation, and tropical medicine. We realise that the latter could well be extended to many months of instruction but we have set our aim at the level of knowledge which should be acquired by the medical officer who is based in a temperate climate and is concerned with transient passengers and aircrew going to and from tropical and sub-tropical areas. We do not intend to train every person to be fully capable with dealing with health problems when based in an exotic climate.

TABLE III - Miscellaneous

	<u>Hours</u>
Parachuting.	6*
Fire Fighting.	8*
Disaster Management.	8
Accidents and Flight Safety.	26*
Radiobiology.	10
Aeromedical Evacuation.	10*

\* Includes Visits

#### Assessment

Having taught our students to the best of our ability, how do the Examiners assess their standard of proficiency and the knowledge of candidates who have not taken the course? Examinations follow what to many must seem an old fashioned pattern. There are two three-hour written examinations, one on aviation physiology and psychology, and the second on clinical topics; there are also two twenty-minute oral examinations similarly divided. It has been suggested that one should adopt a multiple-choice format for examination but we are swayed in our opinions by a consideration which we feel vital. That is, that a graduate should be able to tackle a question which cuts across several disciplines, which exercises his ingenuity, and which requires clarity of expression. The essay type of examination with reasonable scope for the student to exercise choice gives us the best indication of ability in this respect. If each paper includes both discursive and short-answer factual questions, a good assessment of ability can be made.

The course students' success rate has been high, which may be interpreted as meaning that our course is good or that the examination is too easy. We have made strenuous efforts to find out whether our course is in fact adequate and have achieved comforting results from a questionnaire sent to all graduates and another survey of all employers of graduates in which we specifically enquired regarding evidence of adequacy in the performance of their duties. Our ex-students have made a number of suggestions about the balance of teaching in past courses and the Training Section staff make every effort to improve each course in the light of these criticisms. We have our share of problems. Already mentioned have been those subjects which are anathema to doctors, namely statistics and psychology. There are difficulties when we are confronted with students of extremely variable ability in English language and with a wide range of interval between medical graduation and presentation for instruction in aviation medicine. Motivation fortunately appears to have been high in all cases.

So far as staff are concerned it has been difficult to construct programmes to fit in with the very busy schedules of the teachers. This will be particularly evident when one considers that we have employed as many as one hundred different instructors in the course of six months instruction. It has often been suggested that the basic aspect of all subjects can best be taught by a permanent staff of instructors and that only the detailed aspects of the subjects and question-and-answer sessions should be allotted to the more specialised teaching staff. It is of great interest that when this topic has been raised the vast majority of teachers have openly rejected the suggestion and it is a healthy sign that they are willing to continue to devote a reasonable proportion of their precious time to the preparation and delivery of instruction to our students. In some cases it is felt that the instruction would perhaps be improved by a division of time between professional

teachers and research workers and this is a subject for delicate negotiation.

Perhaps our biggest problem which will confront us for the next few years is in the provision of adequate material other than in lecture form. We are conscious that none of the published texts is fully adequate for the requirements of our course. Some books are too detailed in physiology, others in aspects of selection and yet others are too parochial in their outlook. We hope that we will be able to prepare a textbook specifically written around the syllabus as taught at Farnborough. Secondly, we find that although there are very many films available few are of sufficiently high standard and we would like to see more attention given to the preparation of good teaching films. Finally, we would like to see the preparation of programmed teaching for some subjects, particularly those in which differing fundamental ability leads to problems in conventional teaching because of the varied pace at which students can assimilate knowledge. We are indeed fortunate in having the services of the RAF Education Branch at our disposal, since they are particularly advanced in the fields of programmed texts and teaching machines.

TRAINING OF FLIGHT SURGEONS FOR CIVIL AIRLINES

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#### SUMMARY

The history of the U.K. civil airlines and their medical departments subsequent to World War II are described. The vast majority of Flight Surgeons employed between 1946 and 1964 had previous medical training in the armed services. With the contraction of the latter in the sixties, it was necessary to look for recruits from elsewhere.

The setting up of the U.K. Diploma of Aviation Medicine has allowed considerable input from the regulatory and airline medical departments which has ensured that diplomates are civil as well as militarily orientated. Future Flight Surgeons will require to be in possession of this diploma before employment. The development of the Diploma Course to full Faculty status is a logical development as far as the United Kingdom is concerned. There is a great need in this country to ensure the steady flow of suitably qualified doctors into the civil and regulatory medical departments as the aviation industry expands.

## INTRODUCTION

"Voyaging by air has become so safe and so simple a method of passing from city to city or continent to continent that it seems almost unnecessary to write of its medical problems from the point of view of the passenger". So wrote the eminent physician to Imperial Airways in November 1934. What he didn't add was that in the same year one of their aircraft flying between London and Paris encountered headwinds and force landed no less than twelve times due to shortage of fuel! About the same period the degree of drift and strength of winds were calculated on ones performance against the progress of the red double-decker London omnibuses as they progressed down the Edgware Road towards Marble Arch.

Thirty six years have passed since these words were written - fairly momentous years in the history of air transportation taking us to the very borders of outer space and the introduction of the SST aircraft with its attendant problems of protection against high altitude, cosmic radiation, ozone inhalation and high heat loads.

## HISTORY OF CIVIL AVIATION MEDICINE IN U.K.

In the years between we have been lucky in the United Kingdom in having amongst our earliest civil Flight Surgeons eminent men who were trained and tested in World War II. Great strides were made in aviation medicine and technology by all the combatant nations and this was particularly true in our country as witnessed by the setting up of the Royal Air Force Institute of Aviation Medicine at Farnborough and the Royal Naval Air Medical School at Eastleigh, later to be at Gosport and Lee-on-Solent.

The founding of these two famous institutes ensured a steady supply of trained military Flight Surgeons to BOAC and BEA immediately after the cessation of hostilities in 1946 and over the last twenty years or so this has been our ready source of supply. Among these men were physicians such as Air Vice Marshall Sir William Tyrell, Air Marshall Sir Harold Whittingham, Air Commodore J. Kyle, Dr. R.H. Barrett, Dr. K.G. Bergin, Dr. J.E. Gabb and Dr. A.S.R. Peffers but to name a few. Some of these men are no longer alive but they were responsible for the setting up of civil aviation medicine as we know it in the United Kingdom today. The BEA Medical Service developed separately from 1946 onwards under the direction of Dr. Buchanan Barbour who came from the Air Transport Auxiliary, a war-time organization set up to deliver aircraft from the factories to front-line squadrons. In 1964 it was decided to combine the separate medical departments of BEA and BOAC and so the Air Corporations Joint Medical Service was set up to serve the medical needs of both airlines. Our present Director is Dr. J. Graham Taylor.

## PRESENT POSITION OF CIVIL AVIATION MEDICINE

With the run down of military forces in the United Kingdom the supply of trained Flight Surgeons from these sources has practically ceased. In recent years we have had to recruit doctors who have had little or no aerospace medical training and this has produced particular difficulties in our industry. The military Flight Surgeon was able to enter the civil airline with only minimal training as he was already familiar with most of the problems particular to the industry. The direct-entry doctor, on the other hand, had to be trained up to the job which often takes several years.

We were therefore delighted in 1967 to hear that it was intended to set up a Diploma of Aviation Medicine under the aegis of the Royal Colleges of Physicians and Surgeons of England and that we were to be asked to contribute to the construction of the syllabus and have the students for two weeks teaching at London Airport each year. This is now the third year the course has come to us and we have greatly enjoyed the experience.

## THE TASK OF THE CIVIL FLIGHT SURGEON

The Principal Medical Officer (Air) or Senior Flight Surgeon is responsible for medical services associated with the flying side of both airlines. This includes the medical selection, medical maintenance, medical tuition and protection against disease by inoculation of all flying staff. He also supervises the environmental conditions in aircraft and general medical research concerning new aircraft projects, survival equipment, etc.

In addition, he is responsible for the safe carriage of invalid passengers, the medical supervision of the routes and the training of cabin crews in aviation medicine, tropical medicine and hygiene, first aid, emergency midwifery and the medical aspects of survival.

In this task he is assisted by a group of trained Flight Surgeons who are the general practitioners of the flying side of the airlines. It would be pertinent at this stage to examine some of these responsibilities in more detail.

### (1) MEDICAL EXAMINATION OF AIRCREW

Because of the enormous cost of training pilots, both airlines demand very high physical and mental standards on entry. The regulatory body for pilots and flight engineers licences in the United Kingdom is the Board of Trade Civil Aviation Medical Department. Through their agency pilots are medically examined bi-annually, flight engineers annually. These examinations are carried out in accordance with the ICAO Pil/Eng Standards Annex I which are solely concerned with the individual's fitness to fly for the following six months. The airlines, on the other hand, have to take a much longer view of an individual and for this reason the entry examination is of a different character and is concerned with long-term employment on a world wide basis.

Pilots enter the two airlines as, firstly, direct entry pilots from the Royal Air Force, Royal Navy or from other airlines, and, secondly, as ab-initio pilots trained at our own flying training school, the College of Air Training, Farnham, Hants. This college has now been in existence for ten years and supplies some 250 young pilots annually either as schoolboys entering direct from school or University graduates who have already acquired a technical degree. In the selection of these pilots the Flight Surgeon plays a very important role as he has to advise the selection boards concerned on the medical and psychological attributes of applicants. As each applicant represents a great deal of financial investment to the airline, his advice has to be founded on sound values.

(2) MEDICAL MAINTENANCE

A very full consultation service is provided for all grades of flying staff including stewards and stewardesses. The purpose of this is to maintain flying staff at the highest possible levels of physical and mental fitness for the job. Individual members of flying staff are not required to use this service and they can consult any outside doctor if they wish. At present we carry out over 9,000 consultations per year. It must be remembered that the Flight Surgeons have a particular personal insight into the problems of airline flying backed up by first class laboratory, radiology, physiotherapy and dental services all designed to get the man (or woman) back to flight duties as quickly as possible.

(3) MEDICAL EDUCATION

All cabin staff, new entry pilots and engineers are given medical training either in the cabin crew training school or at the pilot training schools. This training is given by the Flight Surgeons and, in the case of pilots, covers the problems of aviation physiology, hypoxia, disorientation, tropical medicine and how to maintain health in world-wide operations. In the case of cabin crews, greater emphasis is given on the care of the passengers, first aid, emergency midwifery and food hygiene, some of the lectures being given by nursing tutors. We give great emphasis to the use of visual aids in the form of films, film strips and cassetted films covering individual subjects. We have, in the light of experience, gone over to multi-choice question examination papers for ab-initio and annual refresher training. The Flight Surgeon in Civil Aviation Medicine must, therefore, be a communicator and able to put over his subject in simple, easily understood language. This latter qualification is particularly important as amongst our cabin crews we have nationals from Germany, France, India, Pakistan, Singapore, Hong Kong and Japan.

(4) RESEARCH AND DEVELOPMENT

It is not the task of an airline medical service to carry out basic research. However, the very rapid progress of the industry has involved flight surgeons in many areas of applied research. These have included pilot work load studies involving many hundreds of flying hours and also work load studies concerning cabin crews in various types of aircraft. In addition, a great deal of work has been carried out in connection with the introduction of new aircraft types. Concorde has been a typical example here as we have taken part in the Anglo-French Concorde studies since the formation of the Aviation Medical Sub-Committee in 1964. This Sub-Committee has met on a regular basis in London and Paris since 1964 and all aspects of supersonic travel as they affect passengers and crew have been considered and recommendations made.

In addition, the introduction of the Boeing 747 carrying some 350 passengers has produced many human factor problems which have been tackled successfully within the airline medical service. In these studies co-operation with the Engineering, Flight Operations and Flight Safety Departments is essential. The PMO(A) also sits on a number of operational committees such as the Control Cabin Requirements Committee, the Aircraft Interior Layout Committee, the Air Safety Committee and weekly meetings of the Flight Operations Department. The number of committees is endless but the foregoing illustrate the extent to which Flight Surgeons are involved in the operational aspects of airline flying.

(5) TROPICAL MEDICINE

BOAC has something in the region of 1,000 aircrew at risk every day as far as tropical disease is concerned. Malaria is still the world's greatest killer and it is vital that all staff are briefed on the medical hazards of travel in tropical countries. The flight surgeon is concerned in the medical education of such staff, ensuring in addition that they take their malarial suppressives and supervise food preparation, the handling of water and milk supplies, the hygiene of premises used by passengers and staff, including the in-flight situation. In this latter connection we are developing on our B.747 an automatic in-flight disinsectisation system to deal with disease vectors.

We have first class laboratory diagnostic facilities to deal with cases of tropical disease returning from overseas. One of our big problems, however, is to educate outside doctors into thinking about the possibility of tropical disease in their patients. Air travel can result in a passenger being bitten by a malarial mosquito in West Africa in the morning and arriving in Oslo, Norway that evening already incubating the disease. The same applies to the dysenteries and other tropical afflictions.

**(6) CARRIAGE OF INVALIDS**

BEA and BOAC carry over 14,000 invalid passengers annually and these vary from serious stretcher cases travelling for definitive treatment to the aged and infirm. In any typical passenger load up to ten per cent may not be in full health and could be affected by air travel. Flying is so easy today that more and more ill and infirm passengers are taking advantage of its facilities. Our Flight Surgeons advise doctors and hospitals wishing to send passengers by air on the possible hazards they may face. In addition, they provide special assistance at airports regarding loading, baggage handling and the provision of stretchers, invalid oxygen sets and other equipment in flight. Special seating can be arranged in advance with extra legroom or situated near toilets for slow walkers. Cabin staff are briefed regarding invalid passenger needs and can give a certain amount of help in flight - but this must not detract from their general cabin service duties. We are not allowed, of course, to carry cases of infectious disease and if the patient is likely to look, act or smell abnormal in any way we must carefully assess his ability to fly with other passengers. Mentally ill passengers must be carefully reviewed individually as they are a potential hazard in an aircraft. Suitable attendants, sedation and supervision at all stages of the flight may be necessary in these cases or they may be rejected completely if they are considered to be potentially troublesome to other passengers and crew members.

**(7) INDUSTRIAL MEDICINE**

Both airlines employ something in the region of 24,000 industrial staff in all processes connected with the maintenance of aircraft and ancillary equipment. Although not the direct concern of the Flight Surgeon, these staff are often involved in hazardous tasks such as the maintenance of high voltage electrical equipment, chrome plating, paint spraying, radiography of metals, microwave radiation and the stripping down of radio-active engine components.

The Industrial Medical Officers are specially skilled in these problems but frequent liaison with the Flight Surgeon on these matters is necessary from time to time.

In addition, all staff exposed to noise are screened audiometrically on joining and at regular set-down intervals, depending on their degree of exposure and work location.

**(8) HYGIENE AND SANITATION**

Both airlines employ specialised hygiene officers who carry out regular inspections of all food preparation areas at home and abroad. In addition, all staff employed in catering establishments have routine health checks and stool tests. Where catering is contracted out to other agencies, particularly overseas, careful checks are made of their standards of hygiene. This also applies to water and milk supplies.

Inspection of crew hotels on a routine basis is also covered by the hygiene officers and here they work very closely with the Flight Surgeons who may be the first to hear from complaining crew members that all is not well at a particular hotel. Pressure may then be necessary on individual hotel managements.

**(9) IMMUNISATION OF PASSENGERS AND STAFF**

All staff operating in hazardous health areas are protected against smallpox, yellow fever, cholera, typhoid and tetanus as laid down by the International Sanitary Regulations. In London we operate our own immunisation service to the travelling public where we carry out over 44,000 vaccinations and inoculations annually. Apart from being a steady source of revenue, this ensures that our potential passengers are correctly documented as refusal of entry by any country means that the carrying airline must return the passenger to his point of embarkation. Flight Surgeons have, therefore, to be well read in the International Sanitary Regulations and the day-to-day world disease picture.

**SUMMARY**

To sum up, the Flight Surgeon in civil aviation must be to some extent a medical 'Jack of all Trades' in that he is involved in a rapidly expanding and forward looking industry which is in the forefront of technological progress. We feel that in the United Kingdom the Diploma of Aviation Medicine provides the necessary background and specialised training for doctors who wish to become Civil Flight Surgeons.

As we have been closely associated with the setting up of the Diploma and the resultant civil part of the curriculum, we feel that students are at present getting the correct mixture of military and civil aviation medicine on the course. We have greatly enjoyed having the first three courses with us for two weeks at London Airport and hope our association with the Diploma Course will long continue. We must persevere in getting well-qualified recruits in this industry if we are to keep abreast, medically speaking, of developments in civil air transportation.

**ACKNOWLEDGEMENTS**

I am particularly indebted to Dr. J. Graham Taylor, my Director, for permitting me to read this paper and to Air Commodore H.L. Roxburgh, CBE, RAF, for his invitation to read it before such a distinguished audience.

### Session II - General Discussion

Dr. Capt. Edmonds (RAF, Chairman ASMT) opened the discussion by commenting on the width of the spectrum of aeromedical training of doctors which had been revealed in the papers. At one extreme was the fully qualified pilot-physician, the FPMO in British parlance, the aeromedical specialists in Clinical, Physiological and Psychological fields, and, at most junior level, what might be called the 'Aeromedical Expert'. He felt that it was time that we asked ourselves two questions; Are we using the best methods of teaching? In terms of cost-effectiveness, are we getting the most use from our trained personnel?

Maj. Sir McLaren (RAF) expressed interest in Dr Vogt Lorenzen's comments on the continuation training of aircrew in aviation medicine. At the RAF Aeromedical Training Centre refresher courses included two seminars, one on general aeromedical topics, the other on aircrew equipment assemblies. Reports on recent inflight incidents are quoted to stimulate discussion. Adequate preparation by directing staff is vital, but given such attention to detail, results are very encouraging; a wide range of topics may be covered and excellent feed-back from aircrew to staff is achieved.

Dr. Preston (UK) commented that much may be gained by study of US airline teaching methods. He had recently visited a training school which had to cope with the problem of training 3,000 stewardesses annually. This was achieved in classes of twenty making much use of response indicators. Capital outlay was very high but the results appeared to be excellent.

Professor Lauchner (GAF) gave the opinion that there was a pressing need for basic aeromedical instruction for all medical graduates. He asked for comment on this subject.

Dr. Preston (UK) supported this whole-heartedly.

Maj. Burden (CAF) stated that in Toronto such training had been proposed for all Public Health Diploma students and the possibility of lectures in the final undergraduate year was under discussion.

Maj. Perry (British Army) called for better aeromedical education of general aviation pilots.

Lt. Col. Dunn (USAF) stated that the FAA had asked for USAF help in the field and that, as a result, on two days in 1970 all 37 Physiological Training Units of the USAF would be open to private pilots. The response was almost overwhelming and the FAA is seeking for additional opportunities to be provided.

OBJECTIVITY IN AIRCREW OPERATIONAL AEROMEDICAL TRAINING

by

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#### SUMMARY

The necessity of effective aeromedical training of operational aircrew is evident from accident and incident records and statistics; examples pertaining to the Canadian Armed Forces are quoted. The requisites of effective aeromedical training, namely knowledge of the mission, adequate training aids, the best use of available instructors, a versatile teaching rationale that can be modified as mission experience dictates, are discussed and illustrated. Follow up training, the use of the practice mission and simulator missions as a training tool, and the various types of briefings that can be given are described and illustrated.

The traditional objective of Aeromedical training is to inform the pilot of his physiological limitations pertinent to his flying task. In meeting this objective, it also follows that he must understand and respect the various components of his life support systems that enable him to perform effectively far outside some of these individual physiological restrictions. The student pilot is given this training during his initial flying course and it is necessary to briefly mention the programme as this is the bed-rock upon which the pilot's future knowledge must be built.

The fledgeling pilot receives a great deal of classroom teaching as a necessary part of his flying training and readily accepts the standard aeromedical programme as defined, for example, in the NATO standard agreement, as part of this training process. To ensure effectiveness at this stage, emphasis must be laid upon the standard of instruction, the relation of classroom training to his air training work, and close liaison between the aeromedical training officers and the flight instructors, so that the more important points, such as oxygen discipline, sudden decompression and disorientation are demonstrated in the air. It is this latter aspect that tends to be neglected during air training and the classroom subjects may not receive adequate reinforcement during the later flying phases of training. An attempt is currently being made to improve this weakness in the Canadian Forces Training Command.

Aeromedical training subsequent to the primary course has comparatively little in common with it in terms of training technique. It has three basic objectives; firstly; familiarity with the life support systems that the trained aircrew members will be using during their tour of duty. Secondly; instruction in the physiological limitations that restrict or modify the operational role of the aircraft, and thirdly; the prevention of unnecessary accidents. This paper examines these objectives and discusses practical questions such as "when should this training be given?" How much should be given? What forms of instruction should be used and how often need it be repeated?"

Meeting the first objective, namely the knowledge of life support systems, is relatively simple. All aircrew on conversion to an operational type of aircraft or on transfer to a different role are normally involved in operational or conversion training, and it is at this stage that they should be given precise instructions concerning their oxygen equipment, cabin pressurization systems, instrumentation and toxicological hazards together with a thorough briefing on the capabilities of the pertinent escape systems. Such a programme should be incorporated in the operational flying training unit syllabus and be an integral part of it. Training aids for this purpose will vary with different countries but at least the basic hardware such as a static ejection seat, oxygen regulators and masks and an aircraft simulator should be available for basic instruction. For aircraft with a flight capability of over 10,000 feet we are convinced of the educational value of a chamber flight using a chamber flight profile appropriate to the worst oxygen and pressure emergency situation that might be met in such an aircraft. The inherent value of such a chamber run lies in the fact that the aircrew member knows he is going to be obliged to use the equipment upon which he is receiving instruction in a threatening (if artificial) environment and therefore attends a great deal more closely and acquires confidence in it more rapidly. The value of repeated individual hypoxia demonstrations or of chamber runs to demonstrate changing susceptibility to decompression sickness is debatable. By the same token an ejection simulator is highly desirable, especially if the mode of actuation or emergency procedure is in any way different from that taught and practiced whilst training, but such simulators are somewhat expensive and are often static installations; a great deal can be achieved by intelligent use of the applicable ejection equipment in the classroom backed up by timing and coordination tests in the flight simulator. At this stage too the aircrew should be made aware of the variations in clothing, harnesses and protective headgear issued to them, together with a resume of its known faults or inadequacies balanced, hopefully, by the philosophy behind its choice. Aeromedical subjects falling into the last two categories of operational effectiveness and flight safety can also be usefully introduced at the operational training unit and these will be mentioned below.

In order to establish the aeromedical requirements to fulfill the flight safety and operational effectiveness objectives it is necessary to study past experience: figure 1 gives some indication of the physiological incident rate experienced by the Canadian Armed Forces in the three year period 1966 - 69. The rate officially reported is shown in the middle line and it will be observed that we can expect approximately two incidents to be reported every 10,000 jet flying hours; such a rate usually indicates only the number of cases where an air emergency was declared and an inquiry instigated. The upper line represents a rate that can be calculated for the incidents of hypoxia, hyperventilation, dysbarism, syncope, toxicological hazards and disorientation using the responses to an anonymous survey carried out by CFIAM in 1965 (1): it includes all aircraft types but refers only to those incidents that the pilot considered were a hazard to his safety or that of the aircraft. The rate indicated by this survey is in the region of six to seven every 10,000 flying hours and is the sharpest picture we can obtain of the serious unreported incidents. A third rate is necessary to complete the picture, and this is found among the accident statistics. The lower line of Fig. 1 shows the jet accident rate in the service, from all causes, in the years under study and although not all of these were physiological, Fig. 2 indicates that in 1968, 66% of the cause factors in these accidents were attributed to personnel (2).

Fig. 1 examines but one side of the coin: the rate of serious and threatening physiological incidents which totals approximately one occurrence every thousand jet flying hours, represents the challenge presented to operational aeromedical training. Obviously many other physiological incidents occur that do not reach dangerous proportions due to understanding and application of the appropriate corrective action; these, reduced by the proportional part played by luck, are the measure of the success of the initial and subsequent training programmes and it is of course extremely difficult to obtain any good figure, but the closest we can get is to return again to the anonymous survey, which was designed to provide a feel for such a question. We find that the rate in this case is approximately fourteen minor incidents every 1,000 hours of total flying.

These figures represent the case for operational aeromedical training and lead us to the question of what we do we teach. Since it is often an aircraft accident rate that eventually determines the amount of effort that will be put into this type of training, accident cause factors will be examined first. Figure 3 (also for 1968) shows the breakdown of the pilot assessed accident causes and is not too helpful in determining an aviation medicine programme, but if we examine more closely the accidents where the primary cause factor was "pilot-error of judgement" it becomes apparent that this label is becoming almost as meaningless as the old concept of "pilot error". In the majority of fatal cases these accidents occurred at altitudes below 2,000 feet and, where we have a post-mortem lactate profile to study (3), it is evident that the pilot was generally unaware of any serious problem until less than fifteen seconds before impact. It is becoming increasingly obvious that the majority of fatal accidents are caused by an inability to perceive a potentially dangerous situation ahead, a normal enthusiasm to carry out the operational flying task, and a time factor, defined by the operational characteristics of the aircraft and its mission, that was too small to allow corrective action to be taken. The accident picture indicates that we should be spending more time teaching such things as visual limitations, common flight illusions, reaction times of man and aircraft, visual workload sharing, instrument limitations, and the maintenance of optimum attention levels.

To examine the causes of incidents, as opposed to accidents, we must again refer to the survey and Figure 4 demonstrates the great predominance of disorientation as the precipitating factor; it also indicates the continuing importance of understanding trapped gas syndromes in sinus and ears and the importance of avoiding heat stress in aircraft. These subjects lend themselves to the accident prevention side of the programme and in the context of the operation can be reviewed during the initial operational training programme. Training in the physiological factors that effect operational effectiveness should be limited on this course to equipment and operational techniques that are part of the aircraft or the expected operation; examples are flash blindness techniques, specific survival data, air to ground target fascination, radar vigilance limits and loss of cabin pressure due to enemy action.

The first requirement of effective operational aeromedical training can now be broadly defined. A course is given in conjunction with the conversion to the operational aircraft and it is related to the role of that aircraft. Brief revision of the principles taught in the training course may be necessary but should not dominate the content of the lecture or demonstration; it should be quite clear to each listener that the subject matter can or will be of direct interest to him during his operational tour and every opportunity to illustrate the subject with actual examples from the command or group should be used. The senior flight surgeon will obviously be deeply involved in the education aspects of such a course though he may well be able to delegate a great deal of the teaching.

In common with the basic course, the effectiveness of such an initial programme will be reduced unless adequate follow-up is provided. This is the second requirement. Experience in the Canadian Forces indicates that periodic formal courses do not achieve this follow up in a satisfactory manner and if poorly taught or merely repetitious will in fact hinder rather than help the operation. Follow-up must be governed by the principles and practice of preventive medicine; professional attitudes towards any complex or hazardous occupation are not acquired as a result of lectures; they are generated by individuals who believe that such an attitude is the most efficient way to execute a task. Safety cannot be forced down peoples throats; attempts to do this can create hazards due to anxiety. Balanced judgements of relative risk are not acquired over-night. Such a follow-up programme must be a process of gentle persuasion and unconscious influencing of current aircrew opinion and there is no doubt that the flight surgeon is in a most advantageous position to initiate such a programme as his clinical training and experience is directed towards the art of persuading people to voluntarily carry out his instruction. Likewise, he has access at least once a year to each individual aircrew member and he, hopefully, has the confidence and trust of the aircrew, in that he has little or no executive authority in the organization.

One of his most effective teaching methods will be to utilize the "briefing of opportunity". These opportunities can be readily found by the command or senior flight surgeon, or by the Base or Station flight surgeon, if actively sought. For example no aircraft accident from which a lesson can be learned should pass without a briefing from the medical member of the board or a senior flight surgeon involved with it. Individual aeromedical incidents which offer no threat of disciplinary action or ridicule to the individual can, with their permission, be used to illustrate pertinent points. Weather briefings if carried out on a squadron basis each morning can be used to make single important points but intrusion into this routine gathering should be short and very much to the point; flight simulation sessions may be used either directly or indirectly to accentuate vital points of instrument presentation and errors of interpretation that have been mentioned in the operational training briefing. The latter however should be done as a very small part of the flight simulator training and should be carried out by the flight simulator instructors. Exercise briefings and debriefings are again an opportunity to make a brief but effective contribution to both safety and effectiveness. The issue of new personal or survival equipment or modifications to existing equipment provides a further opportunity to discuss the strength and weaknesses of current equipment.

In such a programme the active participation and the experience of the senior flight surgeon of the command or group is absolutely essential. He will provide the experience to judge the relative importance of each individual subject, whether it be safety or operational effectiveness, as he works with staff officers concerned in both areas. He is also in a position to boost the individual flight surgeon's efforts by arranging periodic visits of aeromedical and flight safety specialists and to encourage more detailed studies by the more talented and enthusiastic flight surgeons under his command. At the station or base level the junior flight surgeon can also contribute formally by participating in the ground training lectures that often occur at short notice on bad flying days. He can generate interest by tactful aeromedical questions during the annual medical, during sick parade interviews and on informal discussion both in the mess and in the home. It is our experience however, that the talents of the younger

flight surgeon cannot be truly exploited unless adequate leadership is provided by the command or staff flight surgeon.

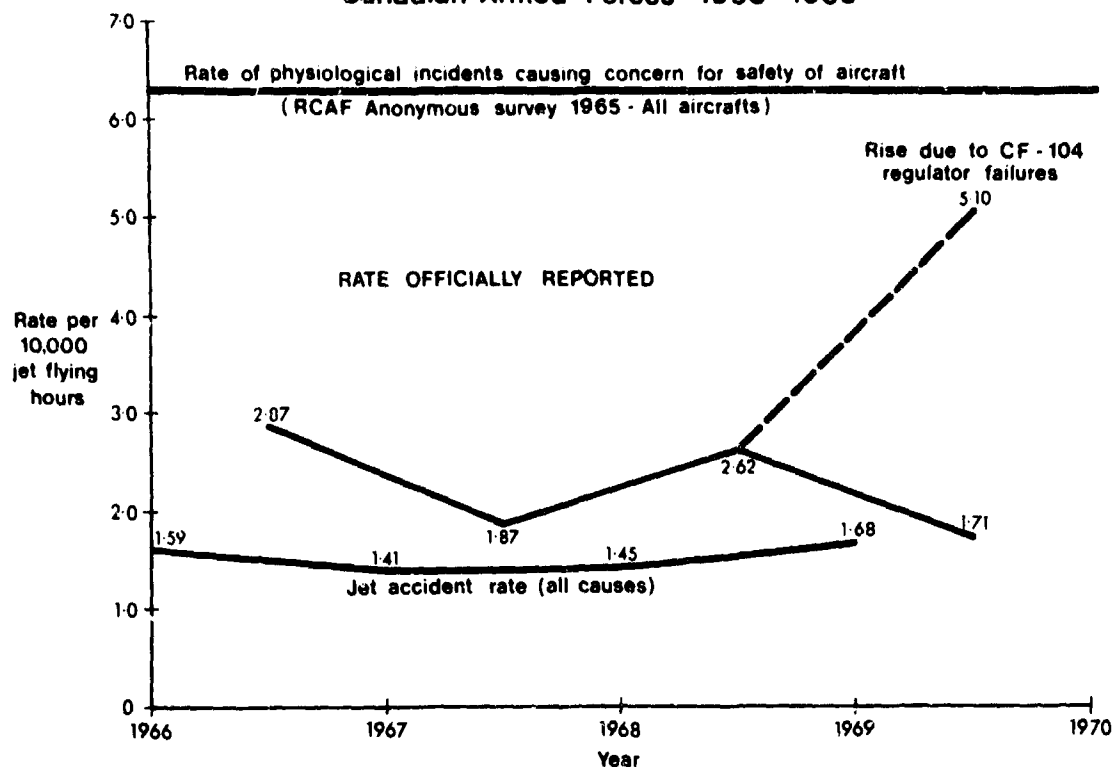
Although this paper has primarily dealt with the training and continuation training of operational aircrew it is recognized that different types of refresher training may be required in the command or group either for the non-operational pilots or for the occasional passenger or technician flying in jet aircraft. These programmes are best carried out at the operational training unit, they should be as brief as possible, and should be applicable to the equipment that the individual is going to use. In the case of passengers or technicians the most economical way to indoctrinate these personnel is to include a basic course on the day prior to an operational training briefing. Since the objective of these "passenger" briefings is to convert a potential flight liability into a potential asset, his participation with the "professionals" on the second day tends to enhance his sense of responsibility and lends validity to the basic training given to him the day before.

To sum up, the following suggestions are made to ensure objectivity in operational aeromedical training. Each aircrew member subsequent to his basic physiological course carried out during flying training should receive an operational aeromedical conversion course whilst doing his operational training; this course should be an integral part of the ground training programme and should be directly applicable to the equipment that he is going to fly. Follow-up training and further aeromedical information should be delivered in a continuous and semi-formal manner by local and senior flight surgeons as the task is primarily one of preventative medicine and persuasion. Hypobaric chambers, ejection and aircraft simulators should all be used where possible but only in context with the aircraft operation. Adequate training of junior flight surgeons and excellent leadership with extensive participation is demanded of the senior flight surgeon and medical staff officer if accident rates are to be reduced and operational effectiveness increased.

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3. FRANKS, W.R. and ANDERSON, I.H. The Value of Post-Mortem Lactate Analyses in Aircraft Accident Investigation. AGARD-ASMP paper 1969.

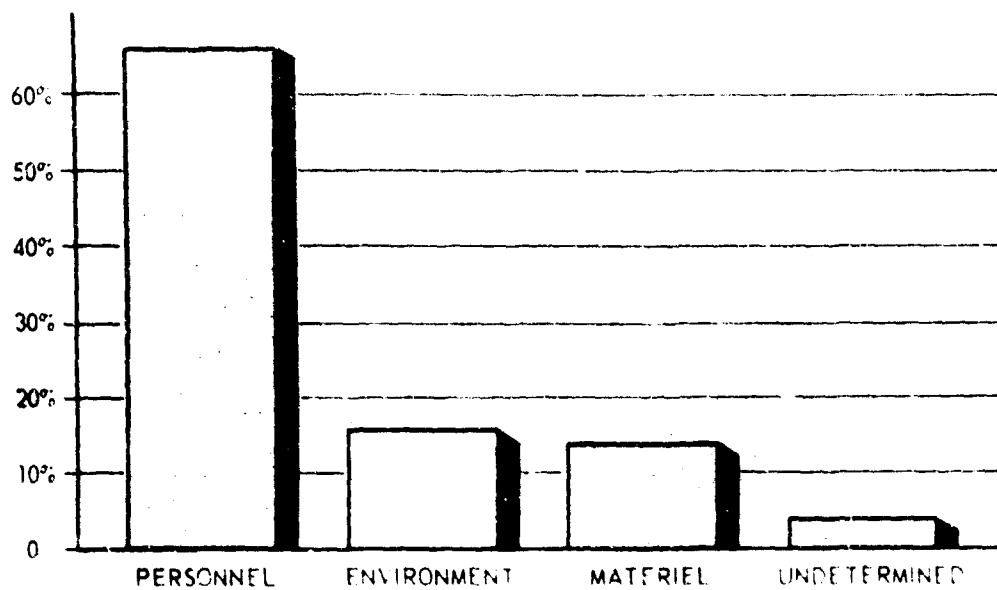
# PHYSIOLOGICAL INCIDENT RATES Canadian Armed Forces 1966 - 1969



Refers to: Hypoxia - Hyperventilation - Dysbarism - Syncope -  
Toxicological hazards - Disorientation

Incident Rates

Fig. 1

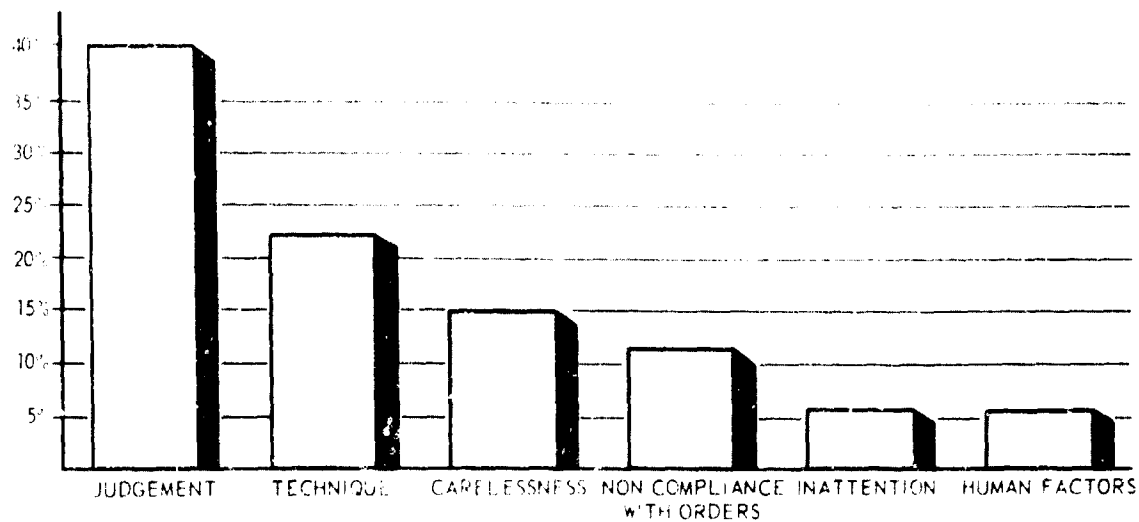


Canadian Armed Forces - Aircraft  
Accident Causes (From Annual Aircraft, Accident Analysis 1968 (2))

Fig. 2

# AIR ACCIDENTS

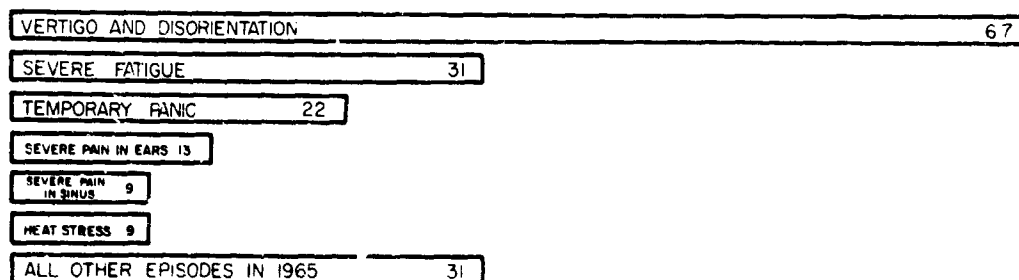
## PILOT



Breakdown of "PILOT" Assessed Cause Factors  
(From: Canadian Armed Forces Aircraft Accident Analysis 1968 (2))

Fig. 3

### AEROMEDICAL EPISODES CAUSING REAL CONCERN FOR SAFETY OF SELF OR AIRCRAFT 224 PILOTS REPORTING ANNUAL RATE PER 1000 YEAR 1965



Aeromedical Incident Survey (Smiley (1))

Fig. 4

PAPER 13 Discussion

Gp Capt Whitely (RAF, Chairman AAMP) asked whether night vision training was in general use. In the RAF very little instruction was given during the early stages of aircrew training. Responses revealed the following:-

Royal Navy A demonstration is given to helicopter pilots, including the effects of hypoxia on night vision

Canada No training

US No training

Germany Demonstration but no personal training given

Norway An orientation lecture is given, but no training

France Practical training is given at the Fighter Training Centre at Tours

Italy A 2-hour demonstration but no training as such

Belgium A lecture but no practical training.

Dr Benson (UK) raised the question of validity of aeromedical training of aircrew. For example, was there any real evidence that intensified training on the subject of disorientation has produced a significant reduction of accidents or incidents from this cause?

Lt Col Dunn (USAF) agreed with the need for validation. Sometimes one might doubt the effectiveness of training. For example USAF pilots undergo practical pressure breathing training every three years but in a recent experiment when aircrew so trained were taken to high altitude in a decompression chamber after being told, falsely, that they would be exposed to an equivalent of 16,000 feet, not one person recognised the onset of pressure breathing.

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Physiological Training of Pilots and Aircrew  
in the German Armed Forces

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## S U M M A R Y

The appliance of modern and highly sophisticated airborne weapons within the German Air Force as well as in the German Army and Navy requires a respective education and training of the flying personnel in Physiology of Flight.

Because of the Geographic Situation of the Federal Republic of Germany this training from the beginning was centrally planned and set up; in consequence all training in Physiology of Flight of all Pilots and Aircrew of the German Armed Forces is done at the Institute of Aviation Medicine of the German Air Force located at Fürstenfeldbruck near Munich, where the basic training as well as advanced training is performed.

The Physiological Training includes a profound theoretical indoctrination into the various topics as well as the application of numerous utensils for the practical training in demonstrations and exercises. This implies not only for instance different types of chamber-flights to simulated altitudes for hypobaric demonstrations but also the use of different types of Ejectionseat-Trainers and mobile Ejectionseat-Towers. Further important topics for practical training are Night-Vision-Training and the demonstration of spatial disorientation, which is done by means of a special Spatial Disorientation Demonstrator, the use of which served very much to the improvement of the knowledge in Physiology of the Labyrinth-Organ.

Since the problems of Physiology of Senses in general gain much of importance, they are to be emphasized as well. Special tools for the education in this matter have been developed and elaborated at the Institute of Aviation Medicine, Physiological Training Division.

The set up of a human centrifuge at our Institute in the near future will be helpful for demonstration of various kinds of gravitational forces in special cases.

Since during or after several forms of the physical training program such as high altitude demonstrations some kind of incident is possible, there must be provided means to counteract e.g. decompression sickness etc. by the use of hyperbaric chambers.

The Flight-Surgeons of the flying units are a great deal helpful in extending the aircrew's knowledge in physiology of the flight.

Based on the geographical situation of the Federal Republic of Germany, appropriate physiological training of pilots and aircrew of the three services of the Bundeswehr (Army, Navy, Air Force) has been planned and established centrally from the beginning. This training has been conducted at the Institute of Aviation Medicine of the German Air Force in Fürstenfeldbruck near Munich for more than 12 years. A central training facility offers the great advantage of uniform training and economical utilization of training personnel and material.

Partially long travel times to the Institute of Aviation Medicine constitute a disadvantage; however the trip does not extend one day in any case; this disadvantage is offset in part by the fact, that prior to the accomplishment of physiological training some of the pilots undergo necessary physical examination at certain intervals in another division of the Institute of Aviation Medicine.

STANAG 3114 constitutes the basis for physiological training in the German Air Force and sets forth directives for the conduct of training of flying personnel. It is the purpose and objective of all training courses to familiarize flying personnel with the performance limits of man and with the physiology of the human organism under special flying stress as well as with the use of rescue and safety equipment.

At the present time we conduct 3 courses for flying personnel. Course A: Physiological training for jet pilots (basic course). Duration of course: 5 days. The course is being conducted after completion of pre-flight training and prior to flying training. The training syllabus includes a total of 40 hours and the following subjects and practical demonstrations:

Course A: Physiological training of jet pilots (basic course)

Total training hours: 40 (5 days)

1. Academic Training

- General topics
- Physical properties of the atmosphere with special consideration of the effects on the human organism
- Physiology of respiration and circulation
- Altitude adaptation of respiration and circulation, hyperventilation
- Oxygen deficiency
- Dysbarism
- Prevention and treatment of hypoxia
- Effects of barometric pressure changes on trapped gases in body cavities
- Utilization and properties of pressurized cabins, decompression, rapid decompression
- Rescue and safety equipment and its use
- Effects of extreme temperatures on the human body
- Emergency ejection, general medical aspects
- Familiarization with ejection seats
- Use of oxygen equipment, pressure breathing
- Forces of acceleration (g-forces)
- Noise, vibrations and supersonic phenomena
- Problems of day and night vision
- Anatomy and physiology of vestibular organs
- Spatial disorientation
- Sensory perceptions and sensory illusions
- Motion sickness
- Aeromedical aspects of special weapons
- General flying suits, flight hygiene
- Toxic gases, vapors and liquids
- First aid treatment of injuries incurred in emergency escape
- Medical aspects of survival

2. Practical Demonstrations

- Ejection seat training (fire seat on mobile trainer)
- Chamber type I flight
- Chamber type II flight
- Rapid decompression
- Demonstration of day and night vision
- Demonstration of spatial disorientation

Training Course B is a refresher course for physiological training of pilots on jet aircraft. Jet pilots having participated in Course A will attend this course every three years. If possible the course will be conducted simultaneously with the follow-up physical examination for flying fitness, which is also performed at the Institute of Aviation Medicine of the German Air Force. With 8 total training hours the course outline is as follows:

Training Course B: Physiological training for jet pilots (refresher course)

Total hours of instruction: 8 (1 day)

1. Academic training:

The most important physiological subjects are covered in abridged version, i.e.

- Oxygen deficiency
- Dysbarism
- Accelerative forces
- Atypical sensory perceptions
- Emergency escape from aircraft
- General personal hygiene
- Use of rescue and safety equipment

2. Practical Demonstrations

- Ejection seat training (fire seat on mobile trainer)
- Chamber type II flight
- Rapid decompression
- Demonstration of day and night vision
- Demonstration of spatial disorientation

In future it is planned to extend this course presently attended by jet pilots only to other pilots and aircrew.

Training Course C is a physiological course of 3 days' duration for pilots and aircrew of propeller- and jet-driven transport aircraft and helicopters. The training syllabus is as follows:

Training Course C: Physiological training of pilots and aircrew of propeller- and jet-driven transport aircraft and helicopters.  
Total training hours: 24 (3 days)

1. Academic Training:

- General topics
- Physics of the atmosphere and its importance for physiology of man
- Physiology of respiration and circulation
- Altitude adaption of respiration and circulation, hyperventilation
- Oxygen deficiency
- Dysbarism
- Effects of barometric pressure changes on trapped gases in body cavities
- Thermoregulation and effects of temperature extremes
- Use of rescue and safety equipment
- Emergency ejection, general medical aspects
- Use of oxygen equipment, pressure breathing
- Effects of accelerative forces (g-forces)
- Noise and vibrations, effects and protection
- Problems of day and night vision
- Anatomy and physiology of vestibular organs
- Spatial disorientation
- Sensory perceptions and sensory illusions
- Motion sickness
- Aeromedical aspects of special weapons
- Flight hygiene, flying suits
- Toxic gases, vapors and liquids
- First aid aboard transport aircraft, reactions to panic
- Medical aspects of survival
- General directives for aeromedical evacuation

2. Practical Demonstrations

- Chamber type I flight
- Rapid decompression
- Demonstration of day and night vision
- Demonstration of spatial disorientation

Besides training courses mentioned here additional physiological training is conducted for flying safety officers, flying safety NCO's, geophysical advisors (meteorologists) and other groups, as required. For this purpose the subject matter is geared to meet the requirements of these specific groups. One of the most frequently held courses is the jet passenger course for the preparation of passenger for jet flight.

Physiological training is conducted by a staff of specialists organized in a stationary and mobile training group. The staff comprises physicians, civil and military instructors and a large number of technical personnel. It is our endeavour to center academic instructions around realistic situations and actual problems by using appropriate demonstration and training equipment. Practical exercises are of particular interest and a more detailed explanation follows.

The different types of chamber flights are conducted in a stationary 20-men-chamber, in a mobile 12-men-chamber or on a stationary 3-men-chamber, which was originally designed for pressure suit training. Pressure suit training has been postponed, since there is no need to use pressure suits at the present time. However, we do have the facilities to conduct pressure suit training; furthermore we already have limited experience in the execution of simulated altitude flights while using partial pressure suits.

The technique of chamber flight type I can best be seen in the following table:

1. a) Seating
- b) Preflight check
- c) Equipment hookup
- d) Preflight denitrogenation
- e) Communications check
2. a) Ear and sinus check
3. a) Use of the specific oxygen equipment used on the flight
- b) Review of acute hypoxia and TUC
4. a) Acute hypoxia demonstration at 35 000 ft
5. a) Acute hypoxia demonstration at 30 000 ft
- b) Use of portable oxygen equipment
6. a) Acute hypoxia demonstration at 25 000 ft
- b) Explanation of buddy system
- c) Special instruction in regard to recovery
7. a) Effect of mild hypoxia on vision
- b) Use of special test cards
8. a) Post flight disposition of equipment

The Type II Chamber Flight Profile reads as follows:

1. Same as on Type I
2. Same as on Type I
3. a) Use of specific oxygen equipment (pressure demand)
4. a) Instruction in proper pressure breathing technique
- b) Instruction in proper verbal communication

5. a) Use and characteristics of emergency oxygen equipment.
- b) Equalization of middle ear pressures.
6. Acute hypoxia demonstration at 25,000 ft.
7. a) Normal descent to ground level.
- b) To be used during actual flight to discuss rapid decompressions.

During chamber flights subjects analogous to the various steps are discussed such as "Abdominal Gas Expansion", "Evolved Gas Dysbarism" etc. Rapid decompression is carried out in the lock of the respective chamber. Subjects are being rapidly raised in altitude from 2,000 ft to 22,000 ft simulated altitude within approximately 2 sec. Rapid decompression is always carried out after completion of type II flight.

For possibly future pressure suit training the following chamber flight profile has been provided. During the one-hour respiratory period already, when the subject is breathing pure oxygen, pressure in the pressure suit is intermittently increased to familiarize the pilot with the changes during pressure increase. At first the chamber is taken up at the rate of 4,000 ft/min. and then at approximately 6-8,000 ft/min. to an altitude of 70,000 ft. After this ascent the chamber is brought down to 25,000 ft and then rapid decompression is carried out to 70,000 ft within approximately 2 sec, followed by descent to ground level. During this process the pressure in the pressure suit decreases from 200 mm Hg to 141 mm Hg. But as stated before, we do not use this chamber flight profile at the present time.

Night vision training is accomplished by means of a self-constructed training device. Satisfactory dark adaptation is achieved by wearing red goggles 30 minutes prior to start of demonstrations. During the demonstrations particular emphasis is placed on autokinetic phenomena, perception of 3-dimensional space using mobile and stationary objects, contrast and contour discrimination under different types of illumination, range estimation, flash blindness and protection. Flashes are generated by using powerful headlights or photo-flashlights. These latter demonstrations are of exceptional didactic value and can not be replaced by any theoretical presentation, however good it may be.

Use of a spatial disorientation demonstrator in physiological training for 1 1/2 years has proved to be exceptionally successful and our program would be unthinkable without it. Applying this training device a number of illusions typical for certain flying situations can be demonstrated in an impressive manner, such as the coriolis-illusion, "lemons", sensations during "graveyard-spin", "oculogyral-illusion" and the "oculogravic-illusion".

Our demonstrator has been modelled with some modifications after a US mockup used at the School of Aerospace Medicine in Brooks AFB, Texas. A light-tight ventilated cabin can be rotated clockwise or counterclockwise and can be moved about its yaw axis simultaneously at variable speed. At the same time the cabin may be tilted 7° about the tangential inside out. During rotations speeds of 0 - 20 revolutions per minute respectively a large number of motion combinations with corresponding angular speeds and accelerations can be generated. Radial accelerations of low intensities also occur. Naturally this equipment does not enable us to perform actual flying manoeuvres, but part of the generated illusions are equivalent to impressions gained in particular flying situations. During demonstrations the trainee in the cabin describes his impressions via voice communications. Demonstrations are most impressive for the observers of the test runs since they can register the discrepancies between subjective perceptions of the "inside" and objective turning movements of the equipment very distinctly. This is particularly true, if the rotational speed to the left is suddenly decreased during a demonstration, which causes the illusion of turning to the right while, objectively speaking, the counterclockwise rotation still continues. The training aid has been equipped with an artificial horizon, whose adjustment can be selectively regulated from the controlpanel outside or by the controlstick inside the cabin. This artificial horizon never reflects the actual attitude or movement of the cabin, but serves to transmit certain tasks to the "inside" such as adjustment to a defined pitch and roll, i.e. changes of the gyro setting by simultaneously demonstrating a particular sensory impression. This serves the ability to suppress subjective sensory impressions and to concentrate attention to certain tasks (control of flight instruments). Furthermore correctness and timely execution of a required control movement during a strong, artificially generated sensory impression may be observed and evaluated. For this purpose we have an appropriately designed controlpanel.

Again it becomes evident, that understanding the problems of physiology of special senses, in this case the labyrinth organs, depends to a large extent upon the manner in which theoretical indoctrinations into anatomy and physiology of the labyrinth organ are conducted. In the near future we shall use a mockup in our lessons, which will illustrate the mechanical processes in the semi-circular canals in a very impressive way; different combinations of movement are generated by a propelling motor on an oversized mockup of the three canals suspended on gimbals, which causes the relative endolymphatic movements to result in cupula motions correlating with the respective rotating sensation. Simultaneously these cupula motions are electronically transferred to a second stationary model, where sensory perceptions associated with this motion can be registered through observation and analysis. At the same time cupula deflections of the three canals are registered per unit time as to direction of movement and intensity of deflection, resulting in an impressive illustration of the correlation respectively discrepancy between objective movement and subjective sensation. Aside from its high didactic value such an equipment respectively model is definitely necessary to demonstrate subjective sensory impressions during motion processes in scientific experiments.

Other important equipment for the execution of practical training includes ejection seat practicing facilities. Because of the manifold types of ejection seats, practical indoctrination into respectively used ejection seats is of significance. It is much easier to give the appropriate introduction into the multiple technical details of a dismantled seat (outside the aircraft), since these are better accessible and their function can be readily surveyed. Various parts of the seat must not only be known but they have to be appropriately checked prior to each flight. For practical ejection seat training we use stationary trainers to train functional processes and practical operations, and the ejection seat indoctrination will be completed by an ejection

seat firing in the mobile ejection seat tower. We have two mobile ejection seat towers at our disposal, which are used for training as required by type of airplane flown. In one tower there is a time delay after pulling the ejection handle, the second seat is fired without delay. Upon firing the ejection seat the g-load amounts to approximately 8-10 g's. The primary purpose of this training is to overcome the inhibitory effect, which is rather high in almost all pilots, as shown by experience. So far only jet aircraft have been equipped with ejection seats and consequently this training is only conducted for jet pilots. It would be desirable if corresponding training for helicopter aircrew would become necessary in the foreseeable future.

Physiological training facilities would be incomplete and inadequate without possibilities of directed therapeutic measures in cases of special incidents. Even though serious incidents are very rare, one has to be prepared for them at any time, especially during simulated high altitude flights. The hyperbaric chamber constitutes the primary rescue device. It must be on stand-by during all simulated high altitude flights, above all, when very high simulated altitudes are reached, such as during pressure suit training. Our hyperbaric chamber has been devised for therapeutic pressures up to 11 ata, corresponding to a depth of water of 100 meters. It is connected to a physiological monitoring unit, which enables us to monitor and record a series of physiological parameters such as ECG, EEG, pneumogram, pneumotachogram, body temperature etc. Incidentally, all our stationary decompression chambers have been connected to this central monitoring unit permitting us to conduct appropriate experimental examinations in the decompression chambers aside from physiological demonstrations. During chamber flights with pressure suits ECG, pulse rate, skin temperature, pneumogram etc. are routinely monitored at all times.

In the near future the Institute of Aviation Medicine of the German Air Force will have at its disposal a very efficient human centrifuge; even though this equipment above all is intended for scientific studies, it will also serve demonstration flights within the framework of physiological training in very specific cases.

In flying units the flight surgeon assigned to the respective organization will continue general and special physiological training of pilots and aircrew through lectures and briefings, whose topics often are questions of a practical and timely nature. Survival chances of pilots and aircrew in cases of emergency are directly proportional to their physiological training level, particularly as far as operation and knowledge of rescue equipment is concerned. Thus, no expenditures should be spared to make physiological training, above all the practical aspects, as comprehensive as possible. These efforts will surely be rewarded by a decrease of the aviation accident rate.

The only objective of physiological training is the maintenance of life and health of flying personnel. This responsibility must therefore be pursued with care and the full utilization of all available resources.

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EDUCATION AND TRAINING IN AEROSPACE MEDICINE  
IN THE ROYAL NETHERLANDS AIR FORCE

by

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### SUMMARY

The physiological training in the Royal Netherlands Air Force started in 1952 under the supervision of the Surgeon General, Royal Netherlands Air Force.

In 1957 the specific training on sea and land survival was intensified, due to a number of fatal accidents and resulted in the foundation of a special centre for survival training: the Flight Safety Training and Test Centre.

The physiological training is given at the Physiological Training Unit at Soesterberg as an integral part of the FSTTC.

Every crew member will undergo this training every 18 months.

In this paper the different courses in aeromedical education are covered and available facilities shown.

### SOMMAIRE

L'entraînement physiologique des Forces Aériennes Néerlandaises a été créé en 1952 sous la responsabilité du Directeur du Service de Santé de l'Air.

En 1957, à la suite d'un certain nombre d'accidents mortels, on intensifia la formation spécifique dans le domaine de la survie sur terre et sur mer, et l'on fonda un centre spécial pour l'entraînement à la survie: le Centre d'Essais et de Formation pour la Sécurité des Vols.

La formation physiologique est donnée à la Section d'Entraînement Physiologique de Soesterberg, qui fait partie intégrante du Centre mentionné ci-dessus.

Les membres du personnel navigant suivent ce stage d'entraînement tous les 18 mois.

Au cours de cet exposé, l'auteur traitera des différents cours de cet enseignement aéromédical, et il décrira les installations existantes.

After World War II, during the reorganisation of the airforce in Holland, the aeromedical training of aircrew was the sole responsibility of the flight surgeon of the base and it depended mainly on his ingenuity in acquiring material for demonstrations and lectures, which topics he covered.

At the time Air Training Command started the pilots training a syllabus on physiological training was set up, in which standard lectures were given by the base flight surgeon.

In 1950 at the introduction of the Gloster Meteor jet aircraft a new program was initiated and physiological training officers introduced, who received their training on the School of Aviation Medicine, Gunther AFB, USA.

After that time the physiological training officers toured the country and gave lectures at the elementary - the advanced - and at the Fighter Training Schools, with a chamber run in the mobile low pressure chamber (fig. 1), which was donated to the medical service by the British Air Ministry.

In 1952 the construction of the low pressure chambers (fig. 2) was completed and a refresher training started for aircrew in our own physiological training centre at Soesterberg.

In 1957 due to a number of fatal accidents in which water survival played an important role the physiological training centre got the order from the assistant Chief of the Air Staff to organize a special course for aircrew which should cover all the aspects of survival after a bail-out from an aircraft.

A two weeks course was introduced which covered the standard theoretical and practical parts of physiological training, dinghy drill, parachute landing simulation, sea and land survival.

As the medical service of the air force was a part of the joint army and air force medical service and as the extra survival course put a heavy burden on the personnel of the Physiological Training Centre an independent Air Force unit was founded, the Flight Safety Training Test Centre at Soesterberg. Col. Verheij will cover the activities of this centre in his presentation, so I will restrict my paper to the physiological training part.

At the moment we have adopted Stanag 3114 as a guide for our syllabus on physiological training for aircrew.

#### Aircrew training.

At the Flying Training School lectures are given in aviation medicine by the flight surgeon and the subjects covered at Elementary Flying Training School are: physical aspects of the atmosphere, physiology of respiration and circulation, hypoxia, aircraft oxygen systems, anatomy and physiology of the eyes, anatomy and physiology of the inner ear and noise protection and physiology of equilibrium.

At the Advanced Flying Training School lectures are given in refresher on physiology of respiration, circulation, hypoxia and eyes - ears and organs of equilibrium. New lectures on dysbarism, acceleration and g-forces, thermal influences on functional adequacy.

After the Advanced Flying Training School students will follow a weeks course at the Flight Safety Training and Test Centre and during this period lectures are given at the Physiological Training Centre in hypoxia, dysbarism, pressure cabins and explosive decompression, pressure breathing, disorientation and escape from aircraft and problems of vision.

Practical demonstrations are given in the low pressure chamber, on the ejection seat trainer (fig. 3), in the centrifuge (fig. 4) and for night vision and in the near future we hope to start with the demonstration of disorientation with the aid of the Spatial Disorientation Demonstrator which will be built by the Lehr Mittel Werkstatte of the German Air Force at Fürstenfeldbruck. At the moment the disorientation demonstration is done with the aid of the centrifuge.

For every

For every type of aircraft there is an Operational Training Unit. If an aircrew is appointed to follow an O.T.U. course he will automatically follow a course at the Flight Safety Training and Test Centre which is set up for that type of aircraft, physiological training is an integral part of every course at the centre and subjects specific to that type of aircraft are covered, like oxygen system, ejection seat, pressure cabin and a refresher on earlier physiological topics. A low pressure chamber run, according to the performance of the aircraft and centrifuge run is standard procedure for the Operational Training Unit course.

Every 18 months the aircrew will undergo a refresher training which is identical to the Operational Training Unit course in which we also cover typical accidents or incidents, related to our topics, which happened in the Air Forces if the reports are made available to us through direct channels or flight safety publications.

The period of 18 months is shorter than indicated in Stanag 3114. However, the Stanag relies on extra lectures given at base level to keep the knowledge on the desired level, but from test-results it is found that it is more useful to send an aircrew member to a special unit away from his own unit to follow a refresher course on different topics.

The one and a half year period was selected to get a change in season for dinghy-drill in open waters and para sailing.

The response of the pilots to these refresher courses are always very positive and our only problem is the hypoxia demonstration during the low pressure chamber run with respect to demonstration material that has not changed for a long time.

At the moment we use the peg board, card box, and writing-tests. We would like some change and welcome any suggestion from the participants of this meeting on tests used in other units which are simple to operate and that give a good demonstration of the effects of oxygen lack.

Since 1960 a special indoctrination course is arranged for Air Defense Command pilots in the use of high altitude equipment and consists of lectures on pressure suit and helmet, pressure breathing, dysbarism and hypoxia after explosive decompression to very low pressures. These lectures and the fitting of the suit and helmet, three pressure breathing sessions and a chamber flight to 80,000 feet and a wet dinghy-drill in pressure suit and helmet will cover a three days period.

#### Training of other categories.

At the Physiological Training Centre courses are also given for conscripted medical officers in aviation and industrial medicine. At the moment this course lasts only one week, as the drafted medical officers already follow a course at the Joint Army/Air Force Medical School for three months, which course covers mainly military topics related to the army medical service. A longer course on aviation medicine would reduce their actual service time as a base Medical Officer too much. However, in the near future the medical officers, who will serve as an Air Force Medical Officer will follow a military officers course at an Air Force Institute and will receive a specific course in aviation and industrial medicine at our Unit.

Flight nurse courses are given at the centre at an "on request" basis. Nurses are recruited from military hospitals and follow a two month course.

Orientation courses are regularly scheduled for technical officers and flight safety equipment personnel as in our Unit safety and oxygen equipment is evaluated.

PAPER 15 Discussion

Professor Lauschny (CAF) asked why the Netherlands had decided upon 18 month intervals between training, rather than 3 years as in the SPANAG.

Major Cartens (R Neth AF) replied that there were two good reasons; firstly, testing of aircrew showed that knowledge had fallen to an unacceptably low level after three years; Secondly, the chosen interval allowed alternate cold and warm dinghy drill training.

Sqn Ldr Johnson (RAF) asked whether Parasail training was liked and/or found useful.

Major Cartens replied that aircrew at first feared the Parasail but after one experience found it enjoyable. It was probably of little value in raising morale with regard to escape training, but with a maximum height of 300 feet it was found that there was time enough to complete major items of parachuting descent drills.

Major Burden (CAF) stated that some Canadian pilots had voluntarily taken a Full Army parachutist training course.

Sqn Ldr Rance (RAF) asked how much pressure-breathing training was given in the Royal Netherland Air Force.

Major Cartens replied that three runs were given at ground level in the EFA suit, pressurized to 50 mmHg for 10 minutes, 100 mmHg for 5 minutes and 140 mmHg for 5 minutes.

Major Burden asked about hypoxia training. To make this more realistic one chamber had been modified so that any one man may be deprived of oxygen without prior knowledge.

Major Cartens was rather against this type of demonstration, giving the opinion that an aircrew member might be "put off" by such an experience.

SURVIVAL TRAINING  
IN THE ROYAL NETHERLANDS AIR FORCE

by

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## SUMMARY

It does not require statistics to prove that all flying personnel should know about survival and get training in survival techniques and procedures.

Anyone who flies should learn to expect the unexpected at any time. To expect, however, is not enough - one must anticipate and prepare for it.

What does it take to survive? The obstacles you have to overcome are not so much physical as they are mental. Aircrew should understand what these psychological obstacles are. They all fall under the general and common emotion called fear.

In any survival situation, the chances of a man winning through are in direct proportion to two factors over which he has direct control:

- a) The will to survive
- b) The knowledge of survival

A third factor could be his survival equipment, but again, without the knowledge of how to use it correctly, its effectiveness will be greatly reduced. Every aircrew should therefore take a positive interest in their aircraft survival pack.

In a sea-survival situation, some extra difficulties are added as for most aircrew the sea is a hostile environment.

Protection must be the first consideration in any survival situation. At sea there are some additional factors that can hamper the survival - seasickness, thirst, hunger and psychological factors like boredom, despair and loneliness.

Experience shows, too often, the tendency of aircrew to panic after entering the water, particularly when little things do not work as advertised. Therefore aircrew must be trained to the point that they can cope with any adversity.

The job of aircrew can, at any time, result in a situation that will extend the endurance to a maximum. Aircrew must maintain a high degree of proficiency in this area, because some day it may save their lives!

## SOMMAIRE

Point n'est besoin de statistiques pour démontrer que tout personnel navigant doit avoir des notions de survie et recevoir une formation concernant les techniques et les méthodes de survie.

Toute personne qui vole devrait apprendre à s'attendre à tout moment à l'inattendu. S'y attendre, cependant, ne suffit pas; on doit prévoir l'événement et s'y préparer.

Que demande la survie? Les obstacles qu'il vous faut surmonter ne sont pas tant physiques que mentaux. Les équipages navigants doivent comprendre quels sont ces obstacles psychologiques. Ils deviennent tous la proie de cette émotion générale et commune appelée peur.

Dans toute situation de survie, les chances de salut pour un être humain sont directement proportionnelles à deux facteurs:

- a) la volonté de survivre
- b) la connaissance de la survie

Son équipement de survie pourrait constituer un troisième facteur de chance, mais, une fois encore, s'il ne sait pas comment l'utiliser correctement, son efficacité sera considérablement réduite. Tout équipage navigant devra donc prendre un intérêt positif à l'équipement de survie dont il dispose à l'intérieur de l'avion.

En cas de

En cas de survie en mer, d'autres difficultés s'ajoutent du fait que, pour la plupart des équipages navigants, la mer constitue un environnement hostile.

Dans toute situation de survie, la protection doit être la première préoccupation. En mer, certains facteurs supplémentaires peuvent nuire à la survie: le mal de mer, la soif, la faim et des facteurs psychologiques tels que l'ennui, le désespoir et la solitude.

L'expérience montre trop souvent que le personnel navigant a tendance à se laisser saisir par la panique après être entré dans l'eau, en particulier lorsque certains petits dispositifs ne fonctionnent pas comme prévu. On doit donc entraîner ce personnel à faire face à toute adversité.

Les équipages navigants exercent une profession dans laquelle, à tout instant, peut se présenter une situation qui va mettre leur endurance à dure épreuve. Le personnel navigant doit conserver, dans ce domaine, un degré élevé de compétence, car ceci peut un jour lui sauver la vie!

With the introduction of jet-engine aircraft the R.N.A.F. was faced with an increased number of accidents. From a study of these accidents it became apparent that pilots who were interested in their safety equipment and that of the aircraft were more likely to use the equipment properly in an emergency.

As no delay could be afforded it was decided to supplement the flight physiology course for pilots with lectures on subjects such as, parachutes, safety equipment, handling emergency-landings.

During the summer of 1957 a series of courses of two weeks were run, where a pilot in operation received theoretical and practical training in the correct use of the safety equipment. The aims of the course were:

- a. Instruction, demonstration and exercise in the physiological problems of an emergency landing and
- b. Instruction, demonstration and exercise in the correct use and handling of safety equipment.

These experimental courses came up to expectations and actually met a long felt need, so the Flight Safety Training and Test Centre was officially founded at Western Air Base in August 1957. In the following years little by little the course developed into an overall training in matters of survival, escape, evasion, etc.

As you all know, survival is something pilots do not like to practice and it is hardly a thing to discuss among pilots. If they do talk about it, it always concerns the other pilot; it is the other pilot who did not use his equipment properly, who got penalty and did not survive. Every pilot thinks he knows all about survival, but if we tell him about the large number of pilots that had the same idea and did not survive we try to give him the motivation to study survival more intensely.

Anyone who flies should learn to expect the unexpected at any time; but to expect is not enough, the pilot must anticipate and prepare for the unexpected. Anticipate the general and some of the specific problems that will be encountered and above all one should be prepared to solve them.

Wherever the survivor may be, he must remember that other people have chosen to live there and with varying degrees of effort, these people have adjusted to the demands of the climate, the terrain and the environment.

However, because the survivor didn't expect to be there, his problem is a bit different. He never really expected to have a bail-out or crash-landing and how well he may be prepared for it, he is probably never completely convinced "that it can happen to him".

In a survival situation the obstacles one has to overcome are not so much physical as they are mental. It is very important that a pilot should understand that these psychological obstacles are that must be overcome. These obstacles all fall under the general heading of that very normal and common emotion called fear.

Fear of the unknown, fear of discomfort, fear of people, fear of ones own weaknesses, fear of the terrain and the climate, as in most cases these are new and strange. And in many cases even though the fears were overcome to some extent, lack of confidence in their own fortitude and ability has broken people, who could otherwise have fared much better.

Though all this is natural, it is not necessary and there are ways of lightening the needless extra burden that these implanted fears will add. The fear of the unknown and fear of discomfort will be alleviated by proper training and briefing, which consists of the geography and the climate of the areas to cross and the methods of getting food and water.

Also adding to his comfort will be the knowledge that the rescue organisation will do anything for his recovery.

Fear of ones own weaknesses is more difficult to overcome, but with considerable outdoor experience in an environment similar to that in which he finds himself will give the pilot confidence in his ability to live of the land. If not, he should take advantage of any opportunity to go through a survival school, where he will have the opportunity to test his skill before it really counts.

On the other

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On the other hand, in any survival situation the chances of a man's winning through are in direct proportion to two factors over which the pilot has direct control:

- a. The will to survive.
- b. The knowledge of survival techniques and procedures.

A third factor could be the survival equipment which is carried in the aircraft, but again without knowledge of how to use it properly, its effectiveness will be greatly reduced.

The will to survive is the most important requirement and without it, a survivor's chance of living through the ordeal are very slim indeed. It is a factor which is difficult to define, it depends on the individuals make up, on his reasons to stay alive and on his determination never to give up, no matter the odds.

Unless the individual has the desire to survive, he will die, no matter how good his knowledge and/or equipment. The will to survive can be impressed upon a person but mostly it is an inherent personal characteristic. It may be prompted by many different motives, dependent on the individual and the cause he is fighting for, but it is an essential requirement for a successful survival.

Knowledge is something that can only be gained and added to over a period of time. It includes the knowledge of the problems likely to be met and how to cope with them; knowledge of the techniques of actively surviving and the knowledge of the correct use of the safety and survival equipment. Knowledge of correct survival techniques will often mean the difference between life and death.

The survival equipment carried in the aircraft is generally of a high standard, but it is necessarily limited by space and weight. Every pilot must take a positive interest in his aircraft and personal survival pack. He must know what is contained in it and how and when to use it.

He should also supplement this equipment by his personal items of survival equipment for such everyday items assume importance out of all proportion in a survival situation.

All of the above mentioned principles form the basis for the survival indoctrination in the R.Neth.A.F. for pilots and aircrew and they are emphasized during the introduction to the different courses that are given. Apart from some theoretical lessons we do give the pilots a very realistic training, so that every pilot has the chance to use his safety equipment in an as near as possible true survival situation.

As a student pilot - before going to the transition phase and fly the T-33 - he has to follow a 5-day course where he is made familiar with the basics of survival. The main subjects taught are flight-physiology, land- and sea-survival. After the pilot gets his wings he comes back to the Centre for a so-called "Combat Survival Course", which also lasts for 5 days. This course has an emphasis on survival in Eastern Europe.

Most of the time is spent outdoors in a more or less uncomfortable condition so the pilot has a chance practice what he has been told during the lectures and find out that it really works. The course is concluded by a short evasion exercise and a demonstration by an interrogation team in which the pilot is the main participant.

As it is very likely that after a bail-out a pilot will make a parachute landing in water, dinghy-drill and swimming is practiced every day. Also parasailing and a helicopter-rescue are in the program.

At the squadron the pilot is required to follow a continuation program and after 18 months he comes back to the Centre for a 3-day refresher course. Apart from some lectures he is kept up-to-date with modifications and chances of his safety equipment.

In our training we tell the pilot a lot about how to survive, but it is up to him to make the best of it. What is really necessary is a clear mind to formulate a plan of action, the physical ability to carry out this plan and - most important of all - the self-confidence and desire to withstand any adversities that he may encounter.

Experience shows, too often, the tendency of a pilot to panic, particularly when little things do not work as advertised. That is why we train the pilot to the point, that he can cope with any adversity and that a formulated plan of action will become an automatic response.

The need for a good physical condition is obvious. The job of a pilot can, at any time, result in a situation, that will extend his endurance to the maximum. Self-confidence is achieved through a thorough knowledge of his safety equipment and survival techniques and procedures. In other words a pilot must maintain a high degree of proficiency in this area, for some day it may save his life.

# Arctic Survival

Dr. G. H. Williams (USA, Dartmouth) complimented the speaker and raised the question of whether any form of training can influence the vital factor, the will to survive.

Professor Williams asked for statements from countries represented at the meeting with regard to the state of survival training. Replies were as follows:-

UK (Army) survival training for winter conditions was conducted in Norway.

UK (RAF) has several schools of survival including Mountbatten (sea and Dartmoor all weathers), a winter survival school in Germany, Jungle and Desert survival schools in the Far and Middle East respectively, and extreme cold courses in Norway. Will to survive was stimulated by the realistic degree of adversity.

UK has Arctic survival schools and conducts Jungle Escape and Evasion training in Panama. The main aim was familiarisation with environment and equipment and the tendency to externalise anger towards the instructor was encouraged.

Italy has survival schools for winter mountain conditions, directed by the Flight Safety Organisation. Sea survival courses actually at sea are restricted to those concerned with air-rescue operations but lessons on this topic are given to all aircrew. There is considerable emphasis on the psychology of survival.

Norway survival training is backed up by extensive individual knowledge of cold mountainous conditions. Annual courses, including a 4-day escape course, are given.

Germany the Navy has a survival centre in Schleswig-Holstein. The land survival training for the Air Force is given at an Army centre, and sea survival is conducted with the Canadian Forces in Sardinia.

Belgium gives basic training at Flying School and 3-yearly courses in sea survival in Corsica. A few selected personnel train in cold-weather survival in Norway.

France conducts theoretical training at Flight School and at unit level and there are mountain and sea survival schools.

Portugal carries out no formal survival training other than theoretical instruction during physiological training, but personnel going to Angola have an intensive 3 day course in jungle survival in Portugal with refresher courses in Angola.

Canada has its main survival school in Edmonton, Alberta for arctic and bush (summer and winter) training. Sea survival is carried out in Sardinia and Halifax, Nova Scotia.

Dr. Preston (UK) asked whether consideration was being given to practical crew training in arctic survival, now that trans-polar and trans-Siberian routes were commonly used. In the BOAC Boeing 707 there was carried cold weather clothing for all crew members, stores, snow shovels etc and a sleeping bag for each passenger but usefulness without practical training might be questioned.

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PHYSIOLOGICAL TRAINING OF AIRCREWS AND COOPERATION WITH  
ENGINEERS IN AEROSPACE MEDICAL PROBLEMS IN FRANCE

by

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## ABSTRACT

### a) PHYSIOLOGICAL TRAINING OF MILITARY AND CIVILIAN AIRCREWS

The physiological training of military aircrews includes lectures and practical demonstrations in low pressure chambers. The lectures are either of a general level (Schools of Aviation), or specialised (test aircrews, high altitude aircraft personnel).

When requested, the military Medical Branch organizes lectures and practical low pressure chamber demonstrations for commercial airline flying personnel, as was the case when long haul jet aircraft were put into service.

### b) COOPERATION WITH ENGINEERS ON MEDICAL PROBLEMS WITH A VIEW TO WORKLOAD AMELIORATION AND IMPROVEMENT IN FLIGHT SAFETY

This complex subject includes aeromedical education in engineering schools: Ecole Supérieure de l'Aéronautique (College of Aeronautical Engineering), Ecole du Personnel Navigant d'Essais et de Réception (School of Test and Acceptance Aircrews); it also involves the maintenance or creation of collaboration with aerospace medical laboratories, the official services of the Technical Board of Aviation, and aircraft manufacturers.

In France, two points should be emphasized:

- the distribution of responsibilities and prerogatives as regards the design and testing of flying personnel protective equipment,
- the concept and language difficulties arising from the highly different training of aircrews, engineers and physicians.

The setting up of an aerospace medical laboratory, integrated into the Flight Test Center and including pilot doctors in its staff, has brought a partial solution to this problem.

## RESUME

### a) ENTRAINEMENT PHYSIOLOGIQUE DES EQUIPAGES MILITAIRES ET CIVILS

L'entraînement physiologique des équipages militaires comporte des conférences et des entraînements pratiques au caisson à dépression, soit de portée générale (Ecoles de l'Air), soit spécialisées (personnel navigant d'essais, équipages d'avions volant à très haute altitude).

Le Service de Santé militaire assure aussi, à la demande, des conférences et des démonstrations pratiques au caisson à dépression pour les équipages de l'Aéronautique civile, comme cela s'est fait par exemple lors de la mise en oeuvre des longs courriers à réaction.

### b) COOPERATION AVEC LES INGENIEURS EN CE QUI CONCERNE LES PROBLEMES MEDICAUX AYANT POUR BUT L'AMELIORATION DE CHARGE DE TRAVAIL ET L'ACCROISSEMENT DE LA SECURITE DES VOLS

Cette question complexe va de l'enseignement de la Médecine Aéronautique dans les écoles d'ingénieurs (Ecole Supérieure de l'Aéronautique, Ecole du Personnel Navigant d'Essais et de Réception) à la collaboration établie ou à établir entre les laboratoires de Médecine Aérospatiale et les services officiels de la Direction Technique Aéronautique et les constructeurs.

En France deux points semblent particulièrement importants:

- le partage des responsabilités et des prérogatives en ce qui concerne la conception et les essais d'équipements de protection au P.N.,
- les difficultés de conception et de langage nées de la formation très différente des membres de l'équipe P.N.-ingénieurs-médecins.

Une solution partielle a été apportée par la création d'un laboratoire de Médecine Aérospatiale intégré au C.E.V. comportant des médecins pilotes.

The very title of this paper indicates that two essentially different matters will be covered. In fact, they have only been put together for the sake of conciseness on the one hand, and, on the other, in order to complement Dr. MISSENARD's paper, thus covering, as far as France is concerned, the overall items mentioned in Memorandum ASMP/554 preparatory to the Symposium on Aeromedical Teaching and Training.

## I PHYSIOLOGICAL TRAINING OF AIRCREW

### 1) General

The term "physiological training" includes a number of training exercises which differ as regards the objectives, the responsibilities and the personnel concerned.

The objectives pursued may be:

- either extensive knowledge of rescue and survival equipment and its use,
- or knowledge of the environment and its effect on the system.

It results therefrom that responsibilities do not fall on the same Services. In the first case the General Duty branch is responsible, in the second it is the Health Service.

The first group includes: simulator training in the use of ejection seats, training in the use of parachutes above sea and ground, in escape from a submerged aircraft, & survival at sea, in a desert, in the mountains, in a tropical area, etc.

The second group includes: night vision and altitude training.

Finally, the personnel concerned may comprise civilian, military or test aircrews. Test-flying crews in particular may have to go through specific physiological training, (for instance, centrifuge simulation of particular accelerations for the purpose of a given flight test).

We shall only consider here the most usual physiological training, provided under the responsibility of the Health Service: altitude training.

### 2) "Conventional" Altitude Training

This is carried out for the Air Force in the low pressure chambers of the Air Force regions, or in that of the Medico-Physiological Research Laboratory at Mont-de-Marsan. As far as test aircrews are concerned, such training is provided in the low pressure chamber of the Aerospace Medical Laboratory of the Flight Test Center at Brétigny-sur-Orge.

As a rule such training includes lectures on the physio-pathological effects of barometric pressure reduction and pressure variations, on the fundamental physiological principles of protection against these effects, and on the use, adjustment and checking of masks and oxygen regulators in use.

Several types of decompression chamber tests may be used according to the specific purpose in view (hypoxia tests, training to high pressure breathing for instance).

No explosive decompression training is provided in France.

Besides their main training role, low pressure chamber ascents are used for the detection of individual susceptibilities to barotrauma, aeroembolism or high pressure breathing.

This "conventional" training to altitude may be given to the flying personnel of civilian airlines, upon their request, by the Aerospace Medical Laboratory. For instance, Air France flying personnel were trained in low pressure chambers prior to putting long-haul jet airliners into service.

### 3) "Special" Altitude Training

#### a) Training of Flying Personnel to the Use of the Partial Pressure Suit

This training has a twofold objective:

- to adapt the suit to the user (adjustment),
- to adapt the user to the suit (indoctrination).

It is given to test aircrews at the Brétigny Aerospace Medical Laboratory, and to military aircrews at the Mont-de-Marsan Medico-Physiological Research Laboratory.

It consists of four sessions:

- (1) Theoretical and practical lecture on the role, construction and use of the various partial pressure suit components. This lecture may be replaced by an instruction film meeting this purpose.
- (2) Suit and helmet size selection, fitting and adjustment.
- (3) Ground training under medical supervision and with continuous heart rate measurement, consisting in five minutes' breathing at a high pressure of 65 mb (50 mm Hg),

followed by five minutes' rest, then ten minutes' breathing at a high pressure of 130 mb (100 mm Hg). Medical supervision consists essentially of monitoring of breathing rate, facial appearance and intercom replies monitoring.

- (4) After one hour's denitrogenation, low pressure chamber test at an altitude of 20,000 m (66,000 ft). This test includes a slow climb at the rate of 30 m/sec (6,000 ft/min) up to 9,000 m (29,000 ft), then after a short simulated level flight, a rapid descent at the rate of 300 m/sec (60,000 ft/min) down to 20,000 m. After a few minutes' simulated level flight at this altitude, during which the subjects perform various piloting or ejection manoeuvres for mobility assessment purposes, a rapid descent down to 12,000 m (39,000 ft), then a descent at a slower rate.

During ground training at a high pressure of 65 mb, no tachycardia other than psychological was observed, and even the latter proved most infrequent. At 120 mb tachycardia and symptoms of insufficient counter-pressure, that is to say physiological disadaptation, are observed exceptionally. When this is the case, a tighter lacing of the suit has always remedied the situation.

It appears from the overall training tests performed so far at Brétigny (approximately 200) that each time ground tests proved satisfactory, climbs in the low pressure chamber were completed without any major incident.

Such incidents may either be attributed to the equipment (for instance, leakage through the seal of the helmet vizor), or to the individuals tested (barotrauma).

Incidents due to the equipment have become very infrequent (less than 1% for the last six years).

Incidents which may be attributed to the individuals tested amount to approximately 3% for the same period of time: these consist of otitis and barotraumatic sinusitis, and mainly of abdominal pains caused by the expansion of abdominal gases (and often resulting from diet errors on the eve of low pressure chamber climb tests).

At the end of the training period, a fitness certificate for flights above 15,000 m (50,000 ft) is granted to the user.

When a new adjustment of the partial pressure suit proves necessary (change in the user's corpulence, for instance), a new ground training period takes place, under the supervision of the unit doctor.

#### b) Other Special Training

Upon specific requests, altitude training adapted to particular cases is provided by the various Aeromedical Laboratories. This may consist in preparation for high altitude flights on light aircraft or gliders, training for high altitude parachute jumps, etc.

## II COOPERATION WITH ENGINEERS CONCERNING WORKLOAD IMPROVEMENT AND INCREASE OF FLIGHT SAFETY

This is a complex question which ranges from aeromedical teaching in Engineering Schools (in particular, Ecole Supérieure de l'Aéronautique and Ecole du Personnel Navigant d'Essais et de Réception), to the collaboration to be created or improved between Aerospace Medical Laboratories on the one hand, and Official Services and Aircraft Industry engineers on the other.

We shall only briefly mention the type of teaching which already exists but deserves to be improved (mainly as regards ergonomics) to draw the attention of the audience to two aspects of the problem raised by collaboration between engineers and physicians, as these two aspects seem to us to be important in France:

- problems raised by the distribution of responsibilities and prerogatives as regards the design, development and homologation tests of aircrew protective equipment, as well as ergonomic problems in general.
- problems related to concept and language divergences resulting from the different training given to engineers and doctors.

It appears that the first group of problems arises from two facts:

- For a long time, two categories of organizations existed in France, and were separated from a hierarchic viewpoint: the Aeromedical Laboratories under the jurisdiction of the Health Service on the one hand, and, on the other the official Services of the Technical Board for aircraft development.
- Besides, doctors only play an advisory part whereas engineers are in a position to make decisions concerning the undertaking of studies (financial support included) and the homologation of material.

The second group of problems results partially from the different languages spoken by physicians and engineers. However, this obstacle is perhaps less important than that created by the differing approaches to the work to be performed. The inclinations and training of a doctor specialized in physiology and psychology are such that he is more attracted to research whereas practical developments will appeal more to an engineer.

All this contributes to the fact that some doctors have lost interest in practical applications, since their opinions were not necessarily taken into account, and have followed their bent towards more basic research.

In fact, it should be realized that a valuable applied study, whether a cockpit, a radar console or protective equipment is concerned, can only be conducted thanks to a close collaboration between engineers and physicians, without overlooking, of course, the indispensable participation of flying personnel who are not only the users, but also define the mission to be fulfilled at the very start.

In other words, at the stage of aircraft and equipment development, or rather at the very design stage, it is indispensable that such a team be set up.

A partial solution to this problem was brought about in France by the creation of an Aerospace Medical Laboratory integrated into the Flight Test Center. As they work on the same spot, under the same command, and on common programmes, doctors, engineers and pilots know each other and get a better understanding of their respective and complementary roles.

It also appears indispensable to differentiate applied physiology research from the application of physiological data to aeronautics. In fact, these form two stages which are also complementary. The purpose of research is to reach a better understanding of the effect on man of the various harmful factors to which he is submitted, of the psychophysiological processes involved in the accomplishment of a mission, or to draw up experimental processes. Application to a mission, or to draw up experimental processes. Application to equipment, systems or aircraft is obviously more concrete. It is also more limited, whereas research often extends beyond the strictly aeronautical field. For instance, some research on respiratory physiology, thermoregulation, wakefulness and sleep rhythms could be equally applied to the Army, the Navy or the Air Force. Besides, while such differentiation exists, one should bear in mind that there is a considerable feed-back. A concrete case, such as an emergency equipment or a weapon system, may give rise to research on a physiology or psychology item as yet obscure.

This is why the solution consisting in merely integrating a laboratory into an engineering institute is only partial. Close liaison and cooperation between the various research laboratories is also indispensable, not only strictly from the viewpoint of application to a given Service (aeronautical, naval, etc.) but also from the viewpoint of basic disciplines. Specialist doctors may thus achieve a proper balance between their inclination towards research and the necessity to apply the results thereof to concrete cases, within a team made up of flying personnel, engineers and doctors.

We believe that a fruitful collaboration with engineers could be achieved through efforts along this line.

Part 17 - Discussion

Professor Lausener (RAF) supported Dr Colin in his plea for close collaboration between doctors and engineers and drew attention to the value of this as demonstrated at NASA establishments, between IAC and AEC in England and with the Flight Test Centre in Germany.

Major Bagden (RAF) agreed with this concept and stated that there are engineer-pilots at the Canadian Forces Institute of Environmental Medicine.

Major Ryrie (RAF) commented on the success achieved in Belgium with the French pressure suit. The only problem in training had been with one case of claustrophobia in the decompression chamber. There had been three incidents of suit inflation due to cabin pressure loss during the course of three hundred high altitude flights in the F104G, and all had been uneventful.

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RESULTS OF POSITIVE PRESSURE BREATHING TRAINING AS SHOWN  
BY PERFORMANCE FOLLOWING RAPID DECOMPRESSION

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#### SUMMARY

One method of providing for the survival of aircrew on exposure to low environmental pressures above 50,000 feet is to use positive pressure breathing techniques with body counter pressure applied through partial pressure clothing.

The aims of aircrew indoctrination in positive pressure breathing are as follows:-

- (a) to enable aircrew to recognise and identify the problems
- (b) to train them to carry out the necessary procedures to minimise the problems
- (c) to assist them to withstand the stresses produced by the problems and to safeguard them in their training programme

This paper describes some of the difficulties of positive pressure breathing training and the methods used to overcome them. The results of such training as measured by aircrew performance on rapid decompression in a decompression chamber are discussed and related to these problems and training methods.

There is a requirement in the Royal Air Force for some aircrew to be trained in the use of partial pressure aircrew equipment assemblies. The use of partial pressure clothing assemblies at high altitude involves the breathing of 100 per cent oxygen at pressures above ambient.

Positive pressure breathing produces a number of attendant problems which are now fairly well known (1). Although training cannot entirely overcome the cardiovascular and soft tissue problems involved, it can do a great deal to teach the student to overcome his respiratory problems. The psychological stresses may be relieved by close, personal supervision by the instructing staff.

#### TRAINING METHODS

The training methods used at the Royal Air Force Aeromedical Training Centre utilise both theoretical and practical sessions. The theoretical aspects are covered by a series of lessons and lectures designed to give aircrew sufficient knowledge of the physiological requirements for oxygen and, in particular, of the need for positive pressure breathing. The untoward side effects of pressure breathing are discussed with the aircrew concerned since we believe that they should be made aware of the reasons for any discomfort which will arise during the practical sessions. These early periods of classroom contact, together with the time spent in individual fittings of equipment allow an essential rapport to be struck between aircrew students and instructional staff.

This personal contact is maintained and fostered by keeping the same staff members allocated to a particular course. Tense students can be observed early on and carefully watched during subsequent training periods on the theoretical aspects dealing with oxygen systems and the more personal aspects of aviation medicine.

The practical training sessions consist mainly of supervised practice in pressure breathing techniques (FIG 1). The final practical session consists of simulating the rapid loss of cabin pressurisation in a decompression chamber. The ground level pressure breathing sessions consist of varying periods of time spent at increasing breathing pressures, culminating in a training bench simulation of the maximum performance of the appropriate oxygen system and aircrew equipment assembly. This aspect of training is completed on the day prior to the decompression chamber run. During training at the lower breathing pressures (FIG 2) sufficient time is allowed for personal instruction and practice in breathing techniques. Physiological monitoring is carried out at all practical sessions following a change either in pressure or in the length of time of exposure to pressure breathing.

This monitoring consists of a print out of an electro-cardiogram derived from chest electrodes, with an accompanying heart rate print. Respiratory system traces consist of an inspiratory pneumotachogram and a measure of expiratory volume (FIG 3). These four-channel traces provide an experienced medical officer instructor with information on the subject's reactions to positive pressure breathing. The aim is to train the subject to achieve a breathing pattern and minute volume similar to those prior to the onset of pressure breathing. At intervals, a successful monitored run is followed by an unmonitored run. Recently some subjects who were having difficulty in achieving satisfactory breathing patterns have been given a visual presentation of their breathing in the earlier stages of training.

The practical sessions permit student and instructor to discuss individual problems and allow individual tuition. Together with the instructor's increasing familiarity with his student's personal, monitored response to pressure breathing this provides an important safety factor in the control of the final practical session - the rapid decompression conducted for each subject in the decompression chamber, following comprehensive individual briefing.

#### TRAINING SAFEGUARDS

The exposure of large numbers of personnel to pressure breathing and simulated high altitude would be fraught with danger if proper safeguards were not in being. These safeguards are continually being revised and updated (2).

As a preliminary to the practical sessions, each individual is seen by a medical officer. His previous flying experience is discussed, together with any previous aviation medicine training. A medical history in relation to his previous flying is elicited and recorded. Any outstanding events in his general medical history are also recorded. An assessment is made of the patency of his Eustachian tubes and condition of his sinuses. As a result of this, very few individuals are prevented from undergoing ground level training, but some are prevented from entering the decompression chamber. These are brought back to the Centre to complete their rapid decompression run when their upper respiratory tract infection has settled.

The monitoring and supervision of ground level pressure breathing training ensures an individual arrives at the decompression chamber trained and fit to undergo his exposure to simulated high altitude. He is monitored in the same way as for ground level training except that there is no respiratory monitoring. The medical officer at the chamber in charge of the decompression has a clear view of the subject. He also has a meter presentation of heart rate and a long memory oscilloscope E.C.G. A second medical officer in the quiet of a monitoring room has a print out record of E.C.G. and heart rate. He is also presented with a picture of the subject on closed circuit television, with zoom, pan and tilt capabilities. These medical officers both have full information on the ground training performance of the individual and are in radio telephone contact with one another. This system of monitoring is essential for the safety and well-being of the subject in our charge.

The exposure to simulated high altitude may possibly give rise to the risk of a few cases of decompression sickness, although the time at altitude is very short. This danger has been virtually eliminated by de-nitrogenation prior to rapid decompression.

## RAPID DECOMPRESSION

It is stressed that the Rapid Decompression experience IS NOT a test of man, material or training. It is regarded as a final training demonstration which the subject does or does not complete rather than one which he passes or fails. Nevertheless, to those responsible for the training it does provide one measure of assessing the effectiveness of that training.

Consequently, an unselected series of 246 individual, monitored rapid decompressions, requiring the subject to breathe 100% Oxygen at a maximum pressure of 70mm. Hg. have been studied retrospectively. (FIG 4).

A breakdown was made of the 'NOT COMPLETED SATISFACTORILY' cases into 'EARLY DESCENTS' and 'ACCELERATED DESCENTS' - an arbitrary but useful division. 'EARLY DESCENTS' represent those who were brought down from that altitude at which they were breathing 70mm. Hg. positive pressures, before the planned time at altitude had elapsed. 'ACCELERATED DESCENTS' represent those who completed the planned time at altitude but who were brought down at a descent rate greater than planned (10K/min). This further breakdown shows 3.7% of the total were brought down early and 6.9% of the total were accelerated on the descent. Most of these - particularly the latter - were of a precautionary nature. (FIG 5).

A further division of figures was made between 187 subjects wearing a jerkin/anti-g suit partial pressure assembly utilising breathing pressure of 70mm. Hg. for 30 seconds at maximum altitude. (FIG 6), and 59 subject wearing a combined partial pressure garment for 60 seconds at maximum altitude and 70mm. Hg. positive pressure. (FIG 7).

There is no significant difference between the two groups. All cases of early and accelerated descents were studied in terms of age, previous experience, response to ground training, recorded cause of alterations in the planned decompression run and the time or altitude at which this alteration was required together with the subsequent rate of descent. (FIGS 8 - 11).

From those records it can be shown that, of the 26 early and accelerated descents, four (15.4%) were due to training or supervisory failures. (FIG 12).

Three (11.5%) were due to a combination of training failures and evidence of physiological stress. (FIG 13).

Nineteen (73.1%) were due to subjective or objective evidence of physiological stress considered unacceptable by the medical officer in charge. Nine of these were associated with marked bradycardia. (FIG 14).

While it is emphasised that the majority of early and accelerated descents are precautionary and do not necessarily compare with the subject's performance in the 'real' situation, it is considered desirable that as many as possible of the subjects complete their pressure breathing training with a satisfactory decompression chamber run. It is evident (FIG 15) that the majority of aborted runs are associated with the physiological stresses involved, (although it appears likely, using heart rates as an index of stress, that considerable psychological stress is also involved). It is in this area of physiological/psychological causes that the greatest improvement in the overall success figures of completed positive pressure breathing will be attained.

## FUTURE INVESTIGATION

A start has been made to compare heart rates of subjects who were brought down prematurely, or more rapidly, with subjects who completed the run normally. Heart rates are noted at Ground Level, immediately prior to Rapid Decompression and immediately prior to enforced or planned descent. Preliminary results suggest that the 'fail' group tend to have more rapid Ground Level heart rates and show a tendency towards an increasing tachycardia up to the time of enforced descent when compared with a normal group. A further comparison is being made of heart rates during the final ground (bench) training and during the decompression chamber run. Although the degree of pressure breathing is the same in both situations, heart rates throughout are notably higher during the chamber run - probable evidence of psychological stress.

Other factors under investigation are:-

- (a) the rate of increase in heart rates
- (b) the degree of bradycardia noted in 'failures'
- (c) the relationship between bradycardia produced while pressure breathing in the decompression chamber and the marked sinus arrhythmias frequently noted in ground level pressure breathing training.

It is hoped that these further studies may point the way to evolving more precise measures of training control for both initial and refresher courses.

## REFERENCES

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FIGURE 1



FIGURE 2

Pressure Breathing Training - Mask/Jerkin/Anti-G Suit Assembly		
2 mins	30mm Hg.	Monitored
3 "	45	Monitored
3 "	45	Unmonitored
4 "	45	Monitored
1½ "	60	Monitored
1½ "	60	Monitored
1½ "	60	Unmonitored
1 1½ "	70 70-0	Monitored
1 1½ "	70 70-0	Monitored

FIGURE 3

## PRESSURE BREATHING RECORDING

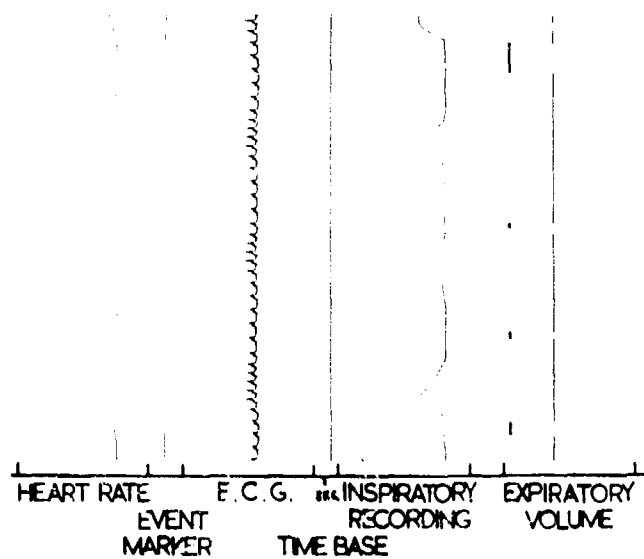


FIGURE 4

S.D. - Breathing 70m ac	246	100%
Completed satisfactorily	220	89.4%
Not completed satisfactorily	26	10.6%

FIGURE 5

Rapid Decompressions - Results		
Normal	220	89.4%
Early Descent	9	3.7%
Accelerated	17	6.9%
Total Rapid Decompressions	246	100%

FIGURE 6

Rapid Decompression 27-56K in 30 secs: 30 secs at 56K: 10K/min descent rate to 40K: P/Q2 mask: Jerkin/Anti-G Suit: Mk 21 Regulator		
Normal	168	89.9%
Early Descents	6	3.2%
Accelerated Descents	13	6.9%
Total	187	100%

FIGURE 7

Rapid Decompression 22-60K in 3 secs: 60 secs at 60K: 10K/min descent to 40K: P/Q7 Mask: Combined Garment; Normalair Stage II Regulator		
Normal	52	88.1%
Early Descent	3	5.1%
Accelerated Descent	4	6.8%
Total	59	100%

**FIGURE 8**

Early Descents (i.e. within 30 seconds) from 70mmHg. breathing pressures at 56,000ft (Jerkin/Anti-G Suit: P/Q2 mask assembly).						
	Age	Previous Experience	Current Bench (Ground Trg)	Time/Rate of Descent	Normal Descent Resumed	Cause
1	40	1962	Satisfactory	20 secs 20K/min	40K	Asymptomatic bradycardia
2	29	1962	Satisfactory (Hyperventilation)	20 secs 40K+/min	40K	Asymptomatic bradycardia
3	22	NIL	Satisfactory (Tachycardia)	Immediate 40K/min	48K	Abdominal gas distension bradycardia
4	25	NIL	Satisfactory (Marked S.A.)	3 secs 20K/min	26K	Subjective discomfort, Nausea Gas distension, 'Stress'
*5	22	1969	Satisfactory	25 secs ?	?	Mask leak (Inflated stole) Subjective discomfort
6	28	1966	Satisfactory	13 secs 20K/min	50K	Mask Leak (Inflated stole) Subjective discomfort

\* Poor monitoring recording

**FIGURE 9**

Early Descents (i.e. within 60 secs) from 70mm Hg. breathing pressures at 60,000ft (Combined Garment: P/Q7 Mask assembly)						
	Age	Prev. Exp.	Current Bench (Ground) Training	Time/Rate of Desc.	Normal Descent Resumed	Cause
1	23	NIL	Satisfactory (Marked S.A.)	30 secs 40K+/min	34K	Abdominal gas distension Bradycardia, Subjective 'Lightheadedness'
2	36	1961	Satisfactory	43secs 30K/min	46K	Abdominal gas distension
3	30	NIL	Satisfactory	38 secs 20K/min	50K	Abdominal gas distension

FIGURE 10

Accelerated Descents (i.e. greater than 10k/min) commencing after 30 secs and between 56k - 40k: Jerkin/Anti-G Suit						
	Age	Prev. Exp.	Current Bench (Ground) Training	Altitude/ Rate of Descent	Normal Descent Resumed	Cause
1	26	NIL	Satisfactory (Marked S.A.)	54K 20K/min	40K	Subjective 'Dizziness' at 25 secs; Bradycardia at 54K
2	21	NIL	"	51K 20K/min	40K	Subjective breathing difficulty; bradycardia
3	31	1964 (Aborted R.D.)	"	53K 20K/min	20K	Gas distension; Nausea Bradycardia (as in 1964)
4	27	NIL	"	55K 20K/min	40K	Mask pressure below 65mm Hg. at 25 secs; Bradycardia
5	24	NIL	Satisfactory	55K 20K/min	46K	Asymptomatic bradycardia
6	37	1964	Satisfactory (S.A.+M.V.++)	44K 40K/min	28K	Hyperventilation, Bradycardia
7	34	NIL	Satisfactory (Marked S.A.)	55K 20K/min	40K	Nausea at 40 secs, Bradycardia
8	21	NIL	"	54K 40K/min	40K	Nausea
9	20	NIL	Respiratory Difficulties	52K 20K/min	40K	Swallowing/Breathing difficulties lost E.C.G.
10	26	1967	Satisfactory	50K 20K/min	20K	Retching
11	21	NIL	Satisfactory (SA-Tachycardia)	52K 20K/min	40K	Subjective Dizziness
12	35	NIL	Satisfactory	52K 20K/min	40K	Abdominal gas distension
13	34	NIL	"	?	?	Total Monitor Malfunction

\* Long 'hold' at 27K prior to Rapid Decompression to get rid of abdominal gas.

FIGURE 11

Accelerated Descents (i.e. greater than 10K/min) commencing after 60secs and between 60K - 40K (Combined Garment; P/Q 7 Mask)						
	Age	Prev. Exp.	Current Bench (Ground) Training	Altitude/ Rate of Descent	Normal Descent Resumed	Cause
1	24	NIL	Satisfactory	45K 20K/min	40K	Subjective discomfort, Dizziness
2	41	1960	Satisfactory (Hypervent.)	50K 20K/min	43K	Subjective discomfort
3	25	NIL	Satisfactory	54K 20K/min	43K	" "
4	38	1959	Satisfactory	59K 30K/min	43K	'Dizziness' Diplopia

FIGURE 12

15.4% of all early and accelerated descents	
Training System Failures	4
Cause	No
Supervisory (inflated stole (mask leak	2
Swallowing/Breathing Difficulties Failed E.C.G. Monitor	1
Total Monitor Loss	1

FIGURE 13

11.5% of all early and accelerated descents	
Physiological/Training Failures	3
Cause	No
Subjective Discomfort ? Psychological Stress (? Inadequate Training)	1
Hyperventilation: Bradycardia	1
Subjective breathing difficulty Bradycardia	1

FIGURE 14

73.4% of all early and accelerated descents	
Physiological Failures	19
Cause	No
Abdominal gas distension only	3
Other subjective symptoms only	7
Asymptomatic bradycardia	4
Bradycardia and abdominal gas distension	3
Bradycardia and other symptoms	2

FIGURE 15

Early/Accelerated Descents - Total Causes			
Causes	NO	%	? Avoidable
Physiological/Psychological	19	73.1	Possibly
Physiological/Training	3	11.5	Probably
Training/Supervisory	4	15.4	Yes

PAPER 18 Discussion

Brig Gen Fuchs (GAF) asked whether the Royal Air Force intended to continue with mandatory pressure-breathing training to 70 mmHg.

Wg Cdr MacLaren confirmed that this was so.

Dr Preston (UK) asked whether an upper age limit was set for pressure-breathing training.

Wg Cdr MacLaren replied that the policy was that, if a man was fit for aircrew duties, he was fit for training in this respect.

Col Brewer (USAF) asked whether cardiac arrhythmia was often seen in pressure breathing training. The USAF had recently had a case of atrio-ventricular block.

Wg Cdr MacLaren commented that some subjects showed an accentuation, others a diminution, of sinus arrhythmia. Occasionally ventricular extrasystoles were seen, one particular series having been associated with the prodromal phase of influenza. Heavy consumption of coffee or tobacco increased susceptibility.

DEVELOPMENT OF PNEUMATIC EJECTION SEAT TRAINERS

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## SUMMARY

The USAF School of Aerospace Medicine has developed a compressed air catapult to be used in connection with Air Force ejection seat trainers. This device insures a safe and economically operated system that can duplicate simulated peak accelerations and rate of onset produced by the cartridge-powered catapult currently used in the USAF Physiological Training Program.

An emergency egress sequence trainer has been designed and developed to include all phases of escape from aircraft, such as ejection, seat separation, opening shock, and parachute landing. This device utilizes a pneumatic-powered ejection seat system which will allow a subject to be fired to a predetermined height where seat separation takes place and a brief free fall to the length of parachute risers that are attached to a carriage and cable assembly which provides a controlled descent capability.

## DEVELOPMENT OF PNEUMATIC EJECTION SEAT TRAINERS

### INTRODUCTION

In spite of the high degree of professionalism employed in the design, maintenance, and operation of our modern high speed aircraft we are constantly faced with the possibility of aircraft accidents. Our major concern is directed in an effort to save the most important entity of these complex systems, a human life. There has been an increase in the percentage of successful ejections from disabled aircraft but a significant proportion of ejections still result in fatalities or major injuries. To this must be added the unknown number of personnel who died because of failure to eject when ejection would have been possible. There are many possible causes of unsuccessful ejection; some within and some beyond the control of the individual. Through proper system design and training the controllable causes of ejection accidents can be reduced to a minimum. Training devices of all descriptions must be utilized to develop skill and confidence in the use of escape equipment.

To provide the aircrew member with the necessary confidence and training, the USAF School of Aerospace Medicine has developed a compressed air catapult to be used in connection with Air Force ejection seat trainers. This device insures a safe and economically operated system that can duplicate the simulated peak accelerations and rate of onset produced by the cartridge-powered catapult currently used in the USAF Physiological Training Program. This project was initiated because of the inherent hazards of the cartridge-powered catapult and the increased maintenance problems encountered in its use.

An emergency egress sequence trainer has been designed and developed to include all phases of escape from aircraft, such as ejection, seat separation, opening shock, and parachute landing. This device utilizes a pneumatic-powered ejection seat system which will fire the subject to a predetermined height where seat separation takes place. He will then experience a brief free fall to the length of the parachute risers that are attached to a carrier and cable assembly, which provides a controlled descent capability.

The above systems are considered significant improvements in safety, economy and the practical aspects of training. We will introduce the new concept in ejection seat trainers by comparing the operation, controllability, cost, safety, and maintenance with the existing cartridge-powered trainers.

### DISCUSSION

This ejection tower is the standard ejection seat trainer currently being used by the United States Air Force. It consists basically of a simulated aircraft cabin, ejection seat, catapult and tower assembly. The instructor evaluates the student's body position and electrically transfers the power to fire the catapult to the student who in turn initiates the ejection.

The M6-A1 catapult assembly, powered by the M-57 cartridge, is the most commonly used catapult. It consists of:

- a. Base - used to mount the device to floor of the trainer.
- b. Outer tube - the firing chamber or cylinder.
- c. Blow-out plug - has rupture disc to prevent over-firing.
- d. Inner tube - acts as piston to lift seat.
- e. Trunion - attaches catapult assembly to seat.
- f. Firing head - fires cartridge that powers the seat.

Acceleration and rate of G force onset is established by the burn rate of the powder. A combination of slow and fast burning powder is used to control the acceleration of the ejection.

Other factors to be considered in its operation are:

- a. The catapult cannot be safely fired more frequently than every five minutes. If it is fired more often, overheating will occur, causing critical inner and outer tube clearance to change, producing overfiring.
- b. The unpredictable characteristics of the cartridge frequently cause overfiring which rupture the blow-out disc at 2,600 psig, necessitating replacement, cleaning of catapult, and restoration of the damaged disc.
- c. Changing of catapults every ten firings is also highly recommended, to allow maximum cooling.
- d. Special handling and storage of ammunition is required.
- e. There are numerous operational restrictions and limitations related to this system.

1. It is evident from the information presented that controllability is unreliable, and improvement is desirable.

Some of the inherent operational hazards which have produced serious injury to operators and students are as follows:

- a. Premature firing while loading and arming warhead of catapult.
- b. Inadvertent firing caused by defective trigger mechanism.
- c. Misfire after firing pin strikes live cartridge.
- d. Removing passenger from seat after misfire.
- e. Removing defective cartridge from warhead after misfire.
- f. Firing seat while catapult is locked.

To be added to the undesirable features is the overwhelming operational cost, as follows:

- a. Catapults cost \$3,800 each with a minimum requirement of three catapults per trainer.
- b. Cartridges cost \$16.60 each, discounting cost for handling and storage.
- c. Manpower cost - a minimum of three operators to safely operate the trainer.

In view of the discussion to this point it is clear that a more practical, economical and safe system should be implemented.

This system is the compressed air or pneumatic system. A few highlights of this system are:

a. A drop-in unit that can convert from cartridge-powered system to compressed air system in 45 minutes without modification or alteration of the basic ejection seat trainer.

b. To date approximately 3,000 aircrew members have been trained with this device, which has been in continuous use at the USAF School of Aerospace Medicine.

c. While in use for over two years this system has operated beyond expectations. There have been no failures, repairs, misfires, injuries, undesirable characteristics, or maintenance problems. The only maintenance has been lubrication and parts inspection, which revealed no evidence of wear or damage.

d. It is simple to operate - can be operated with air compressor or commercial air cylinder. No pyrotechnic required.

e. Frequent replacement of parts and cleaning of catapult are not required.

f. Only one catapult is required per trainer.

g. No firing restrictions are imposed by environmental temperatures.

h. No waiting between ejections is necessary - it can fire as fast as a student can be positioned.

i. Positive control of acceleration and rate of G force onset is a unique feature of this device. It can be adjusted to duplicate specific aircraft systems.

j. All students will receive the identical ejection experience.

The compressed air catapult can utilize all safety features, e.g., safety indicators, lap belt, push button solenoid switch, etc., which are built into the present trainer and contributes the following additional safety features.

a. Remote push button control for arming of system.

b. Remote push button control for safety of system.

c. No danger of misfire.

d. Pressure double balance valve is spring-loaded to closed position to prevent possibility of accidental ejection.

e. Operators do not have to handle explosives.

f. No locking device is required on this catapult.

g. No danger of overfiring.

h. System cannot be ejected without electrical power.

i. Quick disconnect lanyard release to instantly dump accumulator pressure is available if required; however, emergency use is not foreseen because system cannot function without electrical power.

The operational cost saving with the compressed air catapult is impressive.

a. It costs less than \$0.04 per firing, using commercial air cylinders. Fifty-three students can be fired per cylinder, which costs \$2.44 for refill. Cost may be less if compressor is used.

b. Catapult fabrication would cost approximately \$1,000.00.

c. Manpower cost - only one operator is required to safely operate.

An additional instructor could be used to brief and control students waiting to be fired.

The enormous savings, improved quality of training, and tremendously improved safety features of the compressed air catapult compared to the cartridge-powered catapult demands consideration for upgrading the ejection seat training program.

Let us examine the mode of operation. The compressor used is standard and is capable of providing 250 psig pressure or commercial air cylinders with a reduction regulator to establish desired operating pressure. The supply pressure line conveys pressure to the catapult accumulator section. Here pressure can be applied to one side of the double balance valve, forcing it closed and to the other side of the valve, urging it open. Since both valves are on a common shaft, the total effect of the pressure is neutralized and the net result is zero movement. Tension of the heavy valve closing spring keeps the valves closed. The solenoid valve is the actuation device which is electrically matched into the existing firing and safety feature of the conventional ejection seat system without modification. When the subject riding the seat has completed standard ejection sequence already established for this particular trainer and pulls the firing trigger, the solenoid valve opens and allows pressure from the catapult accumulator to enter the chamber in front of the valve opening the piston, which is mounted on a common shaft along with the balance valves. Air pressure acting on the piston exerts a greater force than that of the valve spring causing the piston, along with the shaft, to move toward the center of the cylinder and allowing instant opening of the double balance valves.

With the balance valves in the open position, the air from the accumulator section rushes into the cylinder, firing catapult piston upward, which is operatively attached to the ejection seat. This moves the subject and seat the required distance at the proper velocity. When the catapult piston has traveled approximately two inches upward through the cylinder a pressure conservation switch is activated by a bar and micro switch arrangement on the seat and track, causing the solenoid to close and allows the bleed-off of pressure from the chamber behind the valve opening the piston, causing instantaneous closing of the double balance valves. A relatively small amount of air is needed to accomplish this operation. A drop of only 10 to 20 psig in accumulator pressure is expended.

The USAF School of Aerospace Medicine, in a continuous in-house effort to further improve all aspects of escape training, has designed and developed an Emergency Sequence Trainer to be used with this pneumatic seat. The purpose of this trainer is to provide a method whereby a student can preview the critical phases of escape from a disabled aircraft, in the sequence of actual occurrence, presented in a single experience. Positive control of the student is maintained during all phases of the simulated escape. The series of events are as follows:

- a. Man and seat integration - strap-in procedures.
- b. Pre-ejection procedures - body positioning.
- c. Initiation of the ejection - firing of the ejection seat (12 feet).
- d. Man and seat separation - automatic system.
- e. Free fall - about 12 feet.
- f. Parachute opening shock.
- g. Control of parachute oscillations.
- h. Pre-landing procedures - seat kit deployment.
- i. Parachute landing falls.

The trainer consists of:

- a. Pressure accumulator and firing device.
- b. Loading platform and safety railing.
- c. Seat and track assembly.
- d. Riser separators.
- e. Cable alignment assembly.
- f. Descent control mechanism and carrier reset motor.

g. Descent carrier.

h. Cable anchor - adjustable.

The student steps into the ejection seat which is fired a predetermined height up the tower. Man and seat separation is accomplished by track-mounted micro switch actuation of a solenoid on the seat which is line-fed from a pressure source to a piston-type extraction mechanism. This automatically pulls a network of webbing tight as the piston moves and simultaneously opens the seat lap belt and harness. Subject will continue to decelerate until maximum height is gained and will then free fall the length of his parachute risers. This will be a 10 to 12 foot drop downward and 9 feet forward. At this point the subject will be suspended by the harness which is connected to a controlled descent carrier. This device is composed of a rewind motor, reduction gear box, a magnetic clutch descent control reel and cable, kink prevention device, disc brake, and flyball governor control. When the student reduces oscillations, simulates seat kit deployment and assumes the prelanding positions, the brake is released to allow descent at a controlled rate at the desired angle to perform practical parachute landing fall. The student's rate of descent can be reduced or he can be stopped at any time or position.

In conclusion, the pneumatic ejection seat trainer has significantly realistic, practical, safe, and economical training capabilities that can provide the aircrew member with the proper training and confidence in the use of escape equipment which can and will save his life. This trainer in connection with the procedural trainer gives a practical type device that is controlled from ejection to the parachute landing fall. This allows matching the training to the student on an individual basis, to preclude injuries while deriving maximum learning.

PAPER 19 Discussion

Brig Gen Fuchs (GAF) enquired about the landing injury rate associated with parachuting simulation.

Lt Col Dunn replied that the rate was very low, but nevertheless significant. He understood that there had been two deaths from broken necks in the US Army during use of swing-type parachute landing trainers.

Sqn Ldr Johnson (RAF) commented on the apparent limitation of swing trainers to simulation of forward landings only, the most favourable position.

Lt Col Dunn acknowledged this and explained that it would not appear possible to cater for other directions of landing at the moment, but that modifications were planned.

Wg Cdr MacLaren (RAF) asked whether the trainer described in the paper could be used for training in both automatic and manual sequences.

Lt Col Dunn explained that both were possible.

Dr Benson (UK) asked how accurately the pneumatic propulsion system would reproduce actual ejection seat acceleration profiles.

Lt Col Dunn replied that, by manipulation of the pneumatic accumulator pressure, the solenoid valve and the diameter of the bleed orifice, simulation could be very accurate. So far, the Martin-Baker and F105 seats had been studied in detail. It was noteworthy that the pneumatic trainer was less sensitive to ejected weight variations than the actual seat.

Maj Burden (GAF) asked for actual injury rates to be collected for such training devices. It was interesting to observe that Canada had rejected the use of similar training devices on grounds of risk calculated from USAF figures whereas the USAF had gone ahead with the design of this trainer.

Lt Col Dunn stated that, in his question, the main value was qualitative, not quantitative, in terms of morale-building.

SPECIAL ASPECTS OF THE TEACHING OF RADIOLOGY AND RADIOBIOLOGY  
IN AVIATION MEDICINE

by

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### ABSTRACT

Radiology plays an effective role in many areas of aviation medicine: detection of diseases and selection of candidates, flying personnel fitness control, research, aircraft accident investigations, man's adaptation to equipment.

The teaching of radiology in aviation medicine proves indispensable to acquaint students with some specific aspects of relevant diseases, as well as with the value and limitations of the methods used.

At the selection stage, it is important to know the experts' attitudes and their reasons in evaluating a certain number of facts: normality, the characteristics of which evolve with time, selection criteria in terms of lesions observed and experts' previous positions.

When studying diseases relevant to aviation students should be given a detailed description of the radiological aspects of the main diseases commonly encountered: fracture of the spine, digestive and excretory (urinary for instance).

Students should be warned against the risk of proliferation of X-ray examinations, and it is necessary to set up a number of regulations which should be adhered to in the training given by all the Air Force Medical Services.

Radiology plays an important part in research, and students should be informed about the various technical aspects of subject accommodation in chamber and centrifuge facilities.

In France, the interest of knowing the radiological aspects of the subject seated in various seats is emphasised.

Radiology should also be used in post-mortem investigations. By means of examples selected from recent investigations, it is shown how radiology can be used, and what are the procedures of such examinations.

Finally, radiobiology should be taught with accuracy. Such education is necessary, as in France the teaching of radiobiology in medical colleges is not very intensive (local or general irradiation). The delicate problem of extra-terrestrial radiations and their effects in high altitude flights will be discussed in detail.

### RESUME

La radiologie intervient efficacement dans de nombreux domaines de la médecine aéronautique: dépistage et sélection des candidats, contrôle d'aptitude du P.N., recherches, enquêtes après accidents, adaptation de l'homme au matériel.

L'enseignement de la radiologie en médecine aéronautique s'avère indispensable pour familiariser les étudiants avec certains aspects spécifiques d'affections aéronautiques, pour leur faire connaître la valeur et la limite des méthodes utilisées.

Au stade de la sélection, il faut bien connaître la position des experts, leur raison dans l'appréciation d'un certain nombre de faits: normalité dont les caractères évoluent dans le temps, critères de choix en fonction des lésions observées et des positions prises antérieurement par les experts.

Dans l'étude des affections aéronautiques, la description des aspects radiologiques des principales affections couramment rencontrées (fractures du rachis, affections digestives, (urinaires par exemple) sera détaillée.

Les élèves doivent connaître le risque de prolifération des examens radiologiques et il est nécessaire de fixer un certain nombre de règles qui doivent être suivies dans toutes les formations des Services de Santé des Forces Aériennes.

Dans la recherche, la radiologie joue un rôle important et les élèves seront informés des différents aspects techniques des installations dans les caissons, dans les centrifugeuses.

En France, on insiste également sur l'intérêt de la connaissance des aspects radiologiques du sujet assis sur différents sièges.

La radiologie doit prendre place dans les enquêtes post-mortem. A l'aide d'exemples choisis dans des enquêtes récentes, il est démontré comment la radiologie peut être employée et quelles sont les règles de ces examens.

Enfin, la radiobiologie doit être enseignée en donnant des idées précises. Cet enseignement est nécessaire car en France son étude n'est pas très poussée à l'échelon des Facultés (irradiations localisées, généralisées). Le problème mouvant des radiations extra-terrestres et de leur influence dans les vols à haute altitude sera exposé en détail.

Radiology, the third clinical discipline together with medicine and surgery, plays an increasing part in medical practice. Few studies have been devoted to the problems related to radiology and radiobiology teaching in aviation medicine. However, radiology has an effective role in many areas of aviation medicine: selection of candidates, aircrew fitness control, detection of diseases, aircraft accident investigations, adaptation of hardware to man.

The teaching of radiology and radiobiology proves indispensable in Aeromedical Schools to familiarize students with some specific aspects of occupational diseases, to acquaint them with the value and limitations of the various methods used, the experts' positions, and the general trend of radioclinical research.

- I At the selection stage, students must be aware of the part played by radiology in fitness evaluation. During aircrew selection, a complete check up is made to reject individuals suffering from anomalies or diseases incompatible with flying duties. Two centres of interest engage the attention of radiologists:

- the respiratory tract
- the spinal column

- 1) According to the regulations at present in force in the French Air Force, the following must be accomplished: a radiograph of the lungs during the selection examination, radiophotography at fitness control tests in flying personnel medical inspection centres, and radioscopy during medical examinations in squadron or air base infirmaries.

The Radiophotography reading technique is very important. The student should be familiar with normal aspects and physiological variants. Such training assumes the form of teaching sessions to small groups (5 or 6 pupils at the most). Radiophotography reading takes place under normal reading conditions. Normal films, mixed up with pathological ones, are interpreted by the students at the end of the training period to check their level of knowledge.

Teaching should also emphasize the technique for using thoracic radioscopy. After ten years of contact with the students of the Ecole d'Application de Médecine Aéronautique (School of Instruction in Aviation Medicine), experience has proved that this revision was far from useless, and always appreciated. As a matter of fact, most doctors fresh from medical schools are unaware of the optimum conditions for the use of thoracic radioscopy, and, more particularly, of the rules of adaptation to night vision. At a time when such X-ray exploration is severely criticized, and when its very usefulness is sometimes questioned, we believe that such training is essential and that control of the efficiency of teaching is necessary. We comment on a duplicated book, distributed to the students, which includes all technical indications. During radiography presentations we lay stress on the traps (false images) and particularities of the examination of some areas.

- 2) The Spinal Column

The harmfulness of some flight factors has rendered necessary, in selection operations, the detection of congenital or acquired anomalies, and of static spine troubles, which may form an area of least strength.

The X-ray examination of the spine has a twofold purpose:

- to eliminate severe, clinically silent lesions which are incompatible with aircrew duties,
- to make up a reference record of diagnostic and medico-legal interest.

During the students' assignment at the School of Aviation Medicine, detailed surveys with presentations of radiographs of actual cases stress important points: variations in normality criteria and recommended attitude when faced by congenital anomalies.

Radiologists holding experts' positions in flying personnel medical inspection centres have noticed that normality criteria were changing and that they could no longer be strictly applied. Extensive studies covering over 1,000 adult applicants for aircrew positions show that there are rather considerable variations in radiological aspects; however, these do not necessarily have a practical pathological value. Students should acquire these recent notions, which are not taught in faculties; they would thus learn practical facts. There are very numerous static troubles of the spine (85% according to a recent survey made in France), and their characteristics are described in detail in emphasizing the purpose of this work: to facilitate the flying career of most candidates, and detect the risks of many arthrosis lesions much sooner than ten years ago.

There are a very great number of congenital anomalies, most of which do not modify the strength of the spine. The students learn to recognize each type precisely and the appropriate decisions to make as to candidates' fitness.

- II In the course of current practice, Air Force medical officers encounter a pathology peculiar to flying personnel and diseases which are modified by the profession of flying.

Present regulations provide that plain radiography of the spinal column and, possibly, on the basis of clinical symptoms observed, films of varying techniques and numbers be made following any aircraft accident or incident. Students are given practical training: examination of radiographs of pilots suffering from fractures after ejections or crashes, and of parachutists. Without going into detail, the technique is described with precision as the squadron doctor must know how to formulate an examination and, in front of radiographs, identify technical errors, and be aware of the elective locations of injuries and of their aspects.

During a series of presentations of full scale radiographs (not slides), the main pulmonary, digestive and urinary diseases, and the barotrauma lesions of the ear and sinuses are studied with special emphasis on their aeronautical characteristics. As aircrews are called upon to work in any latitude, radiographs of the main exotic diseases are analyzed and discussed. The experience gained in ten years of practice has shown us that such colloquia are always attended with great interest and that students participate actively in the discussions.

Students should be kept informed of the evolution of techniques, of the preparation of individual patient examination, and of the limitations of the various methods. Students should also be fully conscious of the risks of multiple radiological examinations in personnel to be controlled otherwise from the radiobiological viewpoint. Measures aiming at reducing to an indispensable minimum the irradiation of flying personnel are pointed out.

#### III Radiology in the Special Techniques of Aviation Medicine

Radiology is used in research: in centrifuges, in low pressure chambers, in studies of sitting subjects and in the development of protective equipment (e.g. helmets).

- 1) Radiography of subjects seated in ejection seats facilitates the understanding of the pathogenic mechanism of fractures observed after ejection. The modifications of the spinal statics in the sitting position, and its variations with the subjects's position are illustrated by means of precise and didactic examples. Doctors are thus indoctrinated with the value of seat harness restraint, which should always be tight, and with the necessity of a proper sitting position. These variation factors are analyzed and discussed on the basis of radiological records used on the occasion of some investigations.
- 2) In low pressure chambers, radiological facilities have helped in the investigation of pulmonary lesions following explosive decompression (in animals) and of the influence of decompression on pre-existing pulmonary diseases.
- 3) In centrifuges it is possible to study more particularly the influence of the various types of acceleration on the cardiovascular system by installing image intensifiers and making tape-recordings (Amplex). The various lectures on accelerations and their effects are illustrated by films made on animals. Such facilities exist in France at Brétigny.
- 4) Radiology is used in human engineering studies and examples derived from recent work are shown to doctors.

#### IV Radiology in Aircraft Accident Investigations

Post-mortem radiology provides very important information in the investigations following aircraft accidents. The examination technique is described and the results obtained in recent investigations are analysed.

- V Radiology also contributes to the study of post-traumatic sequelae and their treatment. Colloquia on the role of physiotherapy and kinesiotherapy enable doctors to obtain an insight into the results observed.

#### VI The Teaching of Radiobiology

Military aircraft usually fly at altitudes above 18 km; civilian aircraft will soon reach such altitudes with the advent of supersonic commercial transport. Extra-terrestrial radiation raises various problems which are far from being completely known and understood.

A very accurate study of the pilot's environment in the air should necessarily include a survey of the different varieties of radiation: cosmic galactic, cosmic solar, radiation belts. The composition, the variation factors, the role of solar flares, the physical means of measurement and control peculiar to aircrews flying at very high altitudes are emphasized. A series of lectures familiarize Air Force medical officers with extra-terrestrial radiation and radiobiology. To understand fully the various experts' positions, a very detailed study on radiobiology should be contemplated, the programme of which might be as follows:

- Effect of ionizing radiations on the cell;
- Laws of radiobiology;
- Radiation measurements: measuring instruments in use in the Air Force;
- The units used;
- Linear Energy Transfer and the Quality Factor;
- Effect of ionizing radiation on tissues (blood and hematopoietic organs, skin, gonads, eye, nervous system, digestive system, lungs, embryo);

- Effect of generalized irradiation, clinical forms, value of biological examinations, physiological factors modifying the response of the system (in particular factors due to flight);
- Delayed irradiation effects: radioleukosis, ageing;
- Genetic action of ionizing radiation.

All these detailed problems will enable the student doctor to grasp the difficulty inherent in radiobiological studies in space and the necessity of continuing them. They will also enable him to acquire a valuable scientific culture to participate in discussions during flying personnel indoctrination.

All the characteristics of the use of nuclear weapons in the Air Force are listed and the attitude to adopt in each particular case is specified. This is why we believe it necessary for several lectures to be devoted to external and internal contamination and to decontamination principles. Measures to be taken in the case of peace time accidents are covered by several colloquia.

To conclude, in view of the problems with which they deal, radiology and radiobiology deserve to play a prominent part in the teaching of aviation medicine.

# REPORT OF MEETING: GENERAL DISCUSSION

After a general summing up by the Meeting Chairman, Brig Gen Lauschner, there was general discussion on the subject of aeromedical education and training.

Air Lt Col Polson (RAF) commented on the omission from consideration of helicopter ditching escape training. He outlined the Royal Navy practice of using the "hunking trainer", for training of helicopter crews. It was interesting to observe that the two failures to escape in a recent series of seventy-eight involved untrained passengers.

Dr Rutenfanz (Germany) observed the apparent lack of any ICAO standards for survival training and commented on the tendency of nations to "play down" their familiar environments and accentuate the exotic. Should not a working group be formed to draw up standards?

Prof Lauschner (CAF) pointed out that there was already considerable collaboration between nations in that they shared facilities.

Maj Barden (CAF) commented on the confusion associated with the inclusion of survival training in STANAG 3114, and the problems of division of responsibility between medical and non-medical personnel.

Air Cdr MacLaren (RAF) deplored the confusion engendered by the sub-division of survival into so many categories. Could not a single omni-environmental school be set up?

Air Cdr Fryer (RAF) pointed out that climatic realism was an essential part of training and that it was dangerous to be lulled into a sense of false security, for example, by assuming that warm water wet drench drill was applicable to cold-wet conditions.

Dr Preston (RAF) agreed with the last speaker and felt that we should emphasise the need for active medical participation in planning and execution of survival training.

Gp Capt Whiteside (RAF, Chairman AAMP) supported Dr Preston's views. Was airline survival equipment and training a matter adequately dealt with by ICAO? Was there a need for AGARD AAMP help?

Dr Preston stated that ICAO really gave very little advice. Flight Safety Foundation had been very active in this field.

Dr Missenard (RAF) wished to stress the value of exchange of information on survival training between nations at survival school level. Should there not be an informal exchange of information on the development of survival training and equipment between survival schools, perhaps co-ordinated by AGARD?

Air Cdre Roxburgh (RAF) supported Dr Missenard very strongly, but wondered whether AGARD could legitimately fund training co-ordination since it is a Research agency. There should be an investigation of the stand taken by AGARD directorate on this question. If training could be legitimately included it would be very valuable if a working party could be established to consider the best way to co-ordinate opinion and experience in survival training.

Professor Lauschner agreed with Air Cdre Roxburgh's comments. He felt that, meanwhile, the best aid to collaboration was the continued exchange of students between nations to take part in survival training. He thanked all participants in the meeting, both those presenting papers and those contributing to the discussion. He thanked the Norwegian authorities for their hospitality and the efficient way in which the meeting had been organised. The meeting was then declared closed.

TABULATION OF RESULTS OF  
FLIGHT SURGEON TRAINING QUESTIONNAIRE

by

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FLIGHT SURGEON OR EQUIVALENT TRAINING IN NATO NATIONS  
(ascertained from papers and questionnaires)

NATION/SERVICE	TITLE OF COURSE	SENIORITY OF PARTICIPANTS	PROPORTION OF MO'S TRAINED TO THIS LEVEL	OFFICERS PER CLASS	COURSES PER YEAR
Belgium	Trained in USA or France	4 years service	60% of Air Force Permanent Medical Officers		
Canada	Flight Surgeon	2 years to serve		5 to 10	2
France	Brevet de Médecine Aéronautique	On entry	100%	15 to 20	1
Germany	Primary Course for Fliegerärzte	2 to 5 years service	30%	15 to 20	1
Italy	Medico di Stormo	5 years service	30%	5 to 9	1 or less (in abeyance)
Netherlands	USAF Primary Course	1 year	100%		
Norway	Flight Medical Officers' Course	On entry	100%	15 to 50	2
Turkey	Aviation Medicine Course	Soon after entry	100%	16 average	1
US Army	Aviation Medical Officer + Flight Surgeon	Soon after entry		30 maximum	6
USAF	Primary Course in Aviation Medicine	Soon after entry	100% long service 40% short service	160	3
UK	Diploma in Aviation Medicine + Flight Medical Officer	After about 3 years or more	Not yet known	Up to 16	1

NATION/SERVICE	DURATION OF COURSE	FLYING HOURS	EMBLEM AWARDED	PAY SUPPLEMENT	CONDITIONS IMPOSED
Belgium			None	None	
Canada	8 weeks	As many operational types as possible - approximately 8	Yes	-	Must meet aircrew fitness standards except for eyes
France	18 weeks	70 hours in transport aircraft	Yes	None	None
Germany	10 weeks	8-10 hours passenger or supernumerary crew	Yes (other courses also necessary)	None	None
Italy	22 weeks	10 hours in rescue service flights	None	None	None
Netherlands		20-30 hours dual in Fokker S-11	Yes, after 1 year of practice	None	None
Norway	3 weeks	Up to 2 hours passenger	None	None	None
Turkey	12 weeks	2 hours passenger in T-33	Yes	None	None
US Army	7 weeks	10 hours fixed wing 10 hours helicopter	Yes	\$110 (US) per month flight pay	Flight time 80 hrs/yr for Flight Surgeon
USAF	9 weeks	None	Yes	\$110 (US) per month flight pay	Flight time 4 hrs/month in mission aircraft of Unit
UK	26 weeks	None	None	Approximately \$14 (US) equivalent per month	Diploma pay ceases at Group Captain (Colonel) level of rank

## EDUCATION AND TRAINING IN AEROSPACE MEDICINE

12 - 13 May 1970 - OSLO

TECHNICAL EVALUATION REPORT

by  
Professor Dr Erwin A. Murchner,  
Brigadier General, MC, G.F.

This Specialist Meeting was aimed to exchange information on Education and Training in Aerospace Medicine as practised in the different NATO Nations.

Four Sessions were planned and took place dealing with Education and Training in

- 1) Military Aerospace Medicine for medical and paramedical personnel
- 2) Civil Aerospace Medicine (Universities, Technical Faculties, Societies, Airlines and Aircraft Industry)
- 3) Physiological Training of Pilots, Aircrew, Jet passengers including Survival Training
- 4) Special Training Subjects.

The papers in the four Sessions were well balanced.

Session I had contributions from 7 NATO Nations (Canada, Germany, Italy, France, Norway, United Kingdom and the USA (Air Force and Army).

Variety of courses, main training subjects, course schedules, duration, and number of students were presented and discussed. Emphasis was laid on the professional training of Flight Surgeons or equivalent. It became evident that all courses had the same main subjects but that the distribution of subjects and number of hours per subject as well as the relation of theoretical and practical lectures varied corresponding to the professional level of the participants and the specific tasks to be put upon them after completion of the particular course. The practical follow-up (internship, residency or assistant Flight Surgeon) was also outlined and discussed. A useful exchange of views on training aids and hand-outs took place. The need for a good textbook or manual providing the necessary amount of theoretical and practical knowledge without deviating too much into either basic physiology or specific clinical medicine was stressed.

The question of active flying duty was also raised and thoroughly discussed. The general opinion was that only a few fully trained pilot-doctors are needed in each country but that all Flight Surgeons should get current flying practice in all aircraft their units are equipped with and that a certain amount of basic flying training (including or not solo-flight) could be useful where it could be afforded.

In Session II the same seven Nations contributed, outlining the various possibilities of aerospace medical training for civilians. Training is offered either by special lecture series in universities for medical students or by post-graduate attendance at Flight Surgeon courses in military institutes.

According to national standards a diploma may be issued. In some countries the average medical practitioner can acquire background knowledge, in particular of clinical aviation medicine, in regional post-graduate training programmes.

The necessity to train aeronautical engineers in special aerospace medical subjects has been stressed. Possibilities are given by appropriate lectures in Technical Universities or Engineering Schools and by close co-operation of aeromedical groups with their engineering counterparts in test centers and within the aircraft industry.

The needs for a world-wide aeromedical service in the major airlines was outlined. These medical staffs are only partly recruited from retired military flight surgeons.

The question of cost/effectiveness relation for civil aerospace medical experts was raised. There is only a limited number of posts available in most countries. It was also stated that the average practitioner or clinical specialist needs more aeromedical instruction with regard to the rapidly increasing number of passengers and the equally increasing number of air-travelling patients under ambulatory treatment. Here is a gap to be closed by including appropriate lectures in the medical school programme.

Session III covered the physiological training of military pilots and aircrew. Speakers from 8 NATO Nations contributed. The training programmes followed in general the lines of STANAG 3114 but the emphasis laid on items like accident investigation and prevention or night vision training varied between nations. So did the length of intervals between the refresher courses. All delegates agreed upon the necessity of a good theoretical background and of the correction of basic physiological knowledge by mission-oriented problems. The "physiological incident" (hypoxia, hyperventilation, disorientation, dysbarism, toxic exposure etc.) should be given special attention. Best use of the various possibilities of practical training after dark was stressed. Basic and

refresher courses must be complemented by continuous discussions or even lectures given by the Pilot Surgeon at unit level.

The complex problem of the aeromedical part of the survival training raised much interest. Nearly all countries have survival schools or centers, in particular in line with their own tactical commitments. Although it was recognized that survival training is primarily an air staff responsibility, the aeromedical part of it and its physiological background necessitate close co-operation and perhaps more active participation by aeromedical specialists in its planning. The ASMP Chairman considered the possibility of a specialist meeting on this particular item.

Session IV offered papers on selected items like positive pressure breathing, description of a new pneumatic ejection trainer, simulating all phases of an assisted escape and the important role of radiology and radiobiology in aerospace medicine. Necessity, possibilities and methods of training in these subjects was discussed.

Summary: The scope of this Specialist Meeting was a mutual information exchange on the subjects mentioned above. This aim was well achieved.

A very useful exchange of information and views took place and good ideas and stimuli for amelioration of the theoretical and practical sides of aeromedical training and education were forwarded and discussed.

The proposal was made that the ASMP might periodically collect information on training syllabi and course schedules in the different NATO Nations and pass this information to all panel members concerned.

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